THE SOCIAL CONSTRUCTION OF SUFFICIENT KNOWLEDGE AT AN AMERICAN MEDICAL SCHOOL

by

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GLOSSARY

AGNOTOLOGY: the study of the social construction of ignorance

ANKI DECK: online flashcards used by medical students to study for exams

CASE NARRATIVE/CASE WORKSHEET: a written, fictional description of a patient’s symptoms, history, and treatment plan used by medical students as a basis for group learning in the MCC.

CLINICAL YEARS: the third and fourth years of medical school, which primarily occur in the hospital (i.e. on the wards.)

EMR/EHR: electronic medical record or electronic health record. A computer application used in clinics and hospitals used to collect and save data on patients.

FACILITATOR: a professor, physician, or medical school faculty member who guides and assists medical students as needed in their preclinical training in the MCC.

FIRST AID: the title of a popular book that medical students use to study for exams in the preclinical years.

GRADUATE MEDICAL EDUCATION: internship and residency; i.e. the training that occurs after medical school graduation and before fully independent medical practice as an attending physician.

HIGH YIELD: knowledge that is deemed to be especially important by medical students or their faculty mentors, such that it will 'yield' high exam scores.
INTERPROFESSIONALISM: the practice of training health care professionals together, such that physicians and other clinicians (nurses, pharmacists, social workers, etc.) understand the differences in their forms of practice.

IPE: Interprofessional education (team training of health care professionals)

LOW YIELD: knowledge that is deemed by medical students or faculty members as not worth knowing, typically because it will not 'yield' higher exam scores.

M1: First year medical student

M2: Second year medical student

M3: Third year medical student

M4: Fourth year medical student

MCC: Mock Clinical Course (classroom observation venue, preclinical)

MWSOM: Midwest School of Medicine (pseudonym, field site)

NON-KNOWLEDGE: an alternative term for ‘ignorance’ that is used to refer to the many forms that not knowing may take in social life.

OLO: official (faculty designated) learning objective, in the MCC

PD: physical diagnosis course, the venue in which medical students learn the techniques and skills necessary to physically examine patients.

PIMPING: the process by which medical students, namely in the clinical years, are asked obscure or unexpected questions by residents or attending physicians who are training them, often as an uncomfortable way to test the boundary of the student’s understanding.
PRECLINICAL YEARS: the first two years of medical school, which largely occur in the classroom and laboratory before they receive formal training on the hospital wards.

RABBIT HOLES: a term that medical students use to describe the pursuit of information that is ultimately non-important to the broader and more pressing dimensions of a diagnosis or biological process.

SOM: School of Medicine

SP: standardized patient, a paid actor who pretends to be a patient so that medical students can practice their physical examination skills on them.

SPECIALIZATION: the process of developing narrower, but more rigorous, expertise in a particular area of medical practice.

ULO: unofficial (student designated) learning objective, in the MCC

UNCERTAINTY: the experience of feeling unsure due to gaps in scientific knowledge or ambiguity in existing medical knowledge, such that it is unclear how a patient should be treated and whether the treatment will be effective.

UNDERGRADUATE MEDICAL EDUCATION: the four years of medical school, between graduation from a university with a BA/BS degree and the residency years.

UNIT EXAMS: examinations given to medical students at the end of each unit of the curriculum by the medical school faculty; unit exams are not national standardized exams.

UNITS: themed sections of the curriculum that are approximately four to eight weeks long; an alternative to the semester system, units are based on clustering
together related organ systems or biological mechanisms that students are expected to learn over the first two years of medical school (i.e. the preclinical years.)

UPTODATE: the name of a popular, peer-reviewed encyclopedic website that physicians and medical students alike use to find more information on diseases and medications.

USMLE Step 1/Step 1: Undergraduate medical students’ first standardized board exam
The Social Construction of Sufficient Knowledge at an American Medical School

Abstract

by

JULIA KNOPES

There is too much for individual physicians to know in biomedicine: countless drugs, differential diagnoses, and treatments, all based on the bottomless science of human health. In the face of this overwhelming amount of knowledge, how do physicians learn to make choices about what information they will prioritize, and what they will spare? Drawing on fourteen months of ethnographic fieldwork with medical students in the American Midwest, this dissertation explores how future physicians are trained—implicitly and explicitly—to make conscious choices about what to know and what to ignore in the course of their studies. The author presents a novel theorization of these decisions, termed sufficient knowledge: the process by which medical students are socialized to make choices about what to know, and what to ignore, within both the classroom and the clinic. The author first describes how the field site curriculum conditioned medical student participants to be consciously and intentionally ignorant about some forms of knowledge; second, the author analyzes a series of factors that impact the choices medical students came to make about knowledge and ignorance at the field site, including time, specialization, teamwork, and access to information and material resources. This dissertation acts as a corrective to the extensive body of social scientific research on knowledge and competence in
biomedical practice, suggesting that conscious ignorance is just as instrumental as expertise or skill in understanding the ways that biomedical knowledge is socially constructed.
INTRODUCTION

There is too much to know in biomedicine. Countless drugs, differential diagnoses, treatments, surgeries: all based on the bottomless biological science of human health—and this knowledge is always changing, all of the time, as advances in the biosciences expand and reshape what physicians and scientists thought they knew about disease. As an anthropologist and an ethnographer, I wanted to know how physicians—specifically in their medical school years—are socialized and trained to resolve clinical problems in this expansive epistemological environment. Across fourteen months completing observations and interviews with medical students and their faculty members at an allopathic school in the American Midwest, I learned that medical students and their mentors instrumentalize ignorance to winnow and refine the information they apply to specific patient cases. In other words, medical students learned to make conscious decisions about what information to ignore or deemphasize in order to focus and direct their understanding to the most important and applicable pieces of knowledge for treating patients and mastering medical school exams and assignments. This process, and its product, is what I term “sufficient knowledge.”

I use the term sufficient to mean “of a quantity, extent, or scope adequate to a certain purpose or object (OED 2018). I define sufficient knowledge in my work as the process and the product of prioritizing some forms of information or knowledge over others, such that it is “enough” for the purposes of understanding and resolving clinical cases. Sufficient knowledge must be sufficient for something, and the information that is prioritized should be of an amount, depth,
and quality that it offers an actionable portrait of illness that the physician can respond to. As I will explain further in the literature review chapter, this picture of medical training serves as a corrective to the large body of social scientific research on expertise and competence in biomedicine. I challenge scholars in anthropology, sociology, and science and technology studies to consider the ways in which knowledge and ignorance border and inform one another. Indeed, as the data in this dissertation reveals, the instrumentalization of ignorance is itself an expert skill: one that requires a significant understanding of the contexts in which knowledge will be applied.

Throughout this dissertation, I also use the more inclusive term “non-knowledge” (Japp 2000) interchangeably with “ignorance” to broadly describe the many forms that rifts in knowledge can take, from deviations from knowledge (as Japp indicates) or other informational gaps and spaces. Non-knowledge is used when scholars wish to underscore variations in ignorance and to encourage their colleagues not to view ignorance solely as a void in knowledge that is not socially constructed. As I will present in the literature review chapter and in the ethnographic data chapters, sufficient knowledge is just as much about epistemology (the study of knowing) as it is about agnotology (the study of ignorance) in that it demonstrates how “knowing enough” can mean consciously and actively ignoring some information while centralizing other information. While this dissertation does explore practicing physicians’ encounters with sufficient knowledge, it primarily takes one step back to explore how the format of medical
education in the United States and at my field site initially socializes future physicians to frame, bound, and limit their knowledge for application in practice.

Sufficient knowledge does not exist in a philosophical vacuum; indeed, many situational and social factors can shape what becomes sufficient knowledge and how much knowledge a physician needs to have committed to memory to practice effectively and efficiently. This includes time, access to material and diagnostic resources, specialization, and teamwork. I often remind my peers in the social sciences and humanities that our scholarship, and indeed our knowledge, is limited by similar factors. Doctoral candidates do not have infinite time to study every author in their field, yet the exams they take to advance their training are called “comprehensive.” Scholars become experts in a particular area or discipline of research, but not in others. While they must demonstrate some degree of broader understanding, scholars can also rely on colleagues in neighboring specialty areas and disciplines to provide context and information that they might not have fully mastered; in part, this is the reason we cite fellow authors in our own work. Academics’ ability to produce new knowledge also depends on the use of limited physical and financial resources, be it grant funding, accessible library materials, or equipment necessary for their work.

Yet for all these gaps in knowledge academics are, like physicians, lauded as professional experts. This statement is not meant to romanticize ignorance, but rather to acknowledge the inevitability of incomplete knowledge, and to insist on studying why and how knowledge develops alongside ignorance. The value of ethnography is that as a method, it is able to detect minute, nuanced factors that
shape knowing and not knowing in day-to-day practice and training.

Ethnographic research, in an experience-near way, maps how individuals navigate the conditions of training and practice to develop the necessary skills to both parse out the most critical knowledge, and set aside peripheral information.

Indeed, even the dissertation at hand contends with limitations that may beget ignorance, which are more fully discussed later in this work. The ethnographic research at hand did not directly follow practicing physicians, and instead focused on the ways in which medical students are socialized towards sufficient knowledge. Rather than making claims about the epistemological and agnotological work of physicians, I have chosen to focus on the medical student population. I seek to address this gap by arguing that trends in contemporary clinical practice are mirrored in the ways that medical students learn what to know and not to know. Further, the dissertation draws on medical students’ accounts of clinical practice: including third and fourth year clinical rotations on the hospital wards and first and second year students’ experiences of practice through shadowing. These experiences are included as a means to describe how sufficient knowledge remains an important theme in medical practice in addition to medical education. In the coming sections, I will outline the genesis of this project and briefly overview the content of the forthcoming chapters.

As an ethnographer, I believe it is best to illustrate these ideas through story, thereby stitching together theory and data. This dissertation is replete with the narratives of medical students and physicians, scientists and clinical faculty members. But the first tale I will weave begins with my own intellectual
community of fellow anthropologists, and the assumptions we make about the utility of our work to clinicians. In so doing, I invite readers—anthropologists and other scholars and practitioners—to consider the impossibility of complete knowledge, in both our own work and in biomedical practice. The second story will explore my own encounters with the boundaries of physicians’ biomedical knowledge as a patient, culminating in a description of the new construct I propose in this work, sufficient knowledge.

The first story begins in winter, when January blizzards had descended on my field site, Midwest School of Medicine. It was the kind of weather that made my peers in tropical field sites question my life decisions, as they interviewed their participants with blue seas and bright sun in the backdrop. After presenting my pilot research findings to a motley audience of medical students, anatomists, and social scientists, I zipped myself into my parka and stuffed my laptop into my backpack. I hurried out to the hallway, where two of my medical anthropologist colleagues waited for me. As we strolled past classrooms, and lockers, and my medical student participants bundled in black North Face fleeces, we overheard two of the students griping about their recent seminar on the social scientific and humanistic dimensions of health: what students called (both affectionately and with dismissal) “Touchy Feely Tuesdays.”

I doubt we could have eavesdropped on a more relevant, or worse, part of the conversation between the students. One male medical student in jeans and a t-shirt, devouring leftover pizza, complained to his friend, “Illness, sickness,
disease. I don’t get it. I don’t understand why or when we would need to know that.”

The two anthropologists walking beside me turned to each other with fury burning in their gaze. As we rounded the corner and stepped into the elevator, one of the anthropologists hissed, “Of course they don’t care, of course they don’t see the value in what we do.” She proceeded to berate biomedicine as a medical system, one where clinicians could hide behind the veil of science to avoid addressing structural inequities, discrimination, and the human experiences of health and illness. Why care about the differences between illness, sickness, and disease? We certainly knew the importance and usefulness of these concepts.

My colleague’s concerns were legitimate. I too worried then, and continue to worry, about the potential for harm and social injustice within medical systems. Particularly as someone who works with physicians-in-training, I hope that clinicians become and remain aware of the social, ethical, and personal implications of their practice. I hope that we as medical anthropologists can give them the intellectual tools to do so. Indeed, patients in every circumstance should be cared for by clinicians who believe that health has just as much to do with biology as it does society. Yet as much as my fellow anthropologist and I share these values, I believe that in this instance, my colleague’s vitriol was misplaced.

Medical students and physicians are burdened with an enormous and ever-changing body of bioscientific and clinical knowledge that is not possible to fully master. Ignorance becomes both inevitable and necessary in this
epistemological environment. This does not suggest that today’s medical students and physicians are slacking, or that they do not try their best to learn and apply as much medical knowledge as possible. Indeed, the medical students whose stories are detailed here spent long hours in the library and in study groups pouring over textbooks, review resources, and flash cards. Their ability to memorize large amounts of information, and their talent at interpreting complex diagnostic categories, formulas, and scientific models, were extraordinary if not preternatural. Often, I observed medical students in their later years of training referring to diseases and biological processes that they had learned at the very beginning of their studies. Medical students at my field site—and, I would venture to say, at all medical schools—work with extraordinary dedication, attentiveness, and energy. As I argue in this dissertation, however, part of what makes physicians experts is not just knowledge. It is an ability to sort through information and to understand what information is needed and what knowledge can be spared, even if the span of what one person might master is substantial.

Medical students in my study were both able to internalize large swathes of knowledge while also being adept at limiting knowledge when it was appropriate. They demonstrated remarkable humility and pragmatism by recognizing that they could not know everything, even if they knew quite a lot. The medical students I worked with understood from the early stages of their education that consciously ignoring information was a useful and critical skill, one that enabled them to weigh the pieces of knowledge that mattered most to their work in a variety of contexts. This practice of strategic knowing and not knowing
was not a way to neglect information born out of disinterest or laziness. Put simply, there is too much to know, but medical students can learn to make conscious choices around what to know. Through this process, trainees and physicians alike come to use ignorance as a tool to thoughtfully and meaningfully limit the scope of the most relevant knowledge.

Individual medical students and physicians cannot know everything in biomedicine, even if the knowledge they do cultivate in training and practice enables them to perform highly skilled, and well compensated, medical work. When the medical student in the hallway was talking to his friend, he did not question the value of the knowledge itself, but why it would be necessary. This is not a statement about the inherent importance of knowledge. Instead, it is an invitation to consider under what circumstances this knowledge matters, and advances the work of the physician. If complete knowledge is impossible, medical students must ask these meta-level questions about the information they internalize as trainees. They must be sparing, and calculating, about what both to know and what to not know. Indeed, perhaps rather than identifying experts through knowledge, we might identify experts through their ability to carefully sort through and prioritize information in the most effective fashion.

As I will argue throughout this dissertation, medical students learn to filter out information. They learn and emphasize the knowledge that they perceive to be the most impactful in the situation where it is being applied. Scholars who have passed comprehensive exams as a part of their graduate training should hear their own education echoed in this statement. “Comprehensive” exams are
intended to demonstrate students’ knowledge and ability to articulate the major
themes, theories, and arguments in their field of study. Yet this knowledge is
hardly complete, as any of us who reflect back on our comprehensive exam
bibliographies have found. Think for a moment about what theories, or authors,
or topics are left out from these documents. Consider all of the new research that
has emerged in the meantime. Physicians and academics alike are experts in
their fields, yet to be a practicing expert does not mean that someone has
complete knowledge, even within their own discipline or field of practice. We
cannot know everything.

This is where my second story begins. In it I ask and answer the question
that the first story has left us. If we cannot know everything, and if we do not
need to know everything, what do we choose to ignore? These decisions, both in
the forthcoming anecdote and throughout my dissertation, are highly contextual.
Numerous social and material conditions alter what information is known and
what is ignored, and when, as some information might be useful within certain
cases and useless in others. This time, it is late fall in the American Midwest. The
leaves are dazzling with reds and oranges that would make the anthropologists
shaded by palm trees envious, at least until the snow began to fall in my region
of the world.

I arrived at my doctor’s office and described my recent bout of insomnia,
and what could be causing it. “I don’t know,” she said. My physician adjusted her
glasses and wheeled her office chair across the examination room to the desk,
adding, “I think sleeplessness can occur on your medication, but I’ve never seen
it happen, and I’ve prescribed it to patients for years.” She chattered off a list of more common side effects that she’d encountered with previous patients as she logged onto the computer in front of her. She typed my prescription name into an online diagnostic database emblazoned with the logo *UpToDate*. Upon clicking the search button, a descriptive profile of my medication instantly surfaced on the screen. She pointed at the webpage, which noted *insomnia* near the bottom of a list of side effects. “So you can get insomnia on this drug,” she stated, “but you’re my first patient who’s had it. Everyone else gets tired. And you need sleep to feel better.” After brief deliberation, she encouraged me to use a secondary medication to help me sleep. A few weeks later, I returned to her office for a follow-up appointment without the telltale dark circles under my eyes.

I tell this second story because, upon closer inspection, my physician’s own admission of ignorance offers a glimpse into the entangled ways that knowing and not knowing border one another. My physician did not know about my side effect because she had, to that point, had *enough* of an understanding of the side effects that she was able to advise patients before me. She could overlook insomnia because out of all the other side effects it was an outlier: she never needed to memorize this side effect to treat other patients. Further, given the enormous expanse of biomedical knowledge that all physicians contend with, my physician could scarcely focus on an uncommon side effect of one medication whenever she had too many common conditions and treatments to know for her daily work in a busy primary care practice.
Yet, when faced with a gap in her knowledge in my case, she was able to access more information rapidly online and provide an evidence-based response to my concern about sleeplessness. She was also able to implement knowledge that she did have on medications to alleviate insomnia, such that she generated a treatment plan that suited my individual needs as a patient. My physician was neither fully knowledgeable nor completely ignorant. She was able to resolve this mismatch in her knowledge and my illness condition within the space of our appointment time by locating the necessary knowledge to confirm her clinical judgment online. In sum, she had the amount of knowledge on my medication that was appropriate for the needs of most patients, though she could rapidly access the more specialized knowledge that was sufficient for my needs.

The way that my physician resolved a gap in her knowledge for the purposes of my case reflects, in large part, how medical students today are oriented towards both knowledge and ignorance. As I alluded earlier, this is the core thread that runs throughout this dissertation. Through 14 months of ethnographic fieldwork at a medical school in the American Midwest, which I call by the pseudonym “Midwest School of Medicine,” I discovered that medical education positions future physicians to be sparing and thoughtful about what they know. At the same time, they learn to actively parse out the information unnecessary for the patient cases they study as trainees. I discovered that while medical students are trained for knowledge—to become applied experts in biomedicine—they are also conditioned to consciously ignore, overlook, or set aside information on the cases they encounter when that information is not
relevant, informative, or meaningful. This is, in sum, how medical students come to respond to an epistemological landscape in which they cannot possibly know everything.

Sometimes, like in my case, physicians learn to de-emphasize uncommon symptoms and to develop a working knowledge of more common and acute complaints that they will see in the clinic. In other instances, medical students are habituated to overlook the granular details of a physiological process to bring a more systemic, broader understanding of human biology into focus. They learn to place patients’ social histories at the center of cases on psychiatry, while prioritizing anatomy for surgical cases. Through training, physicians learn what types of knowledge to focus on—from applied technical skills, to scientific models of disease, and emerging theories of illness—and when, and what pieces of information to overlook. They also learn to contend with external factors that curtail or impede their knowledge, such as the limited time with patients in appointments to develop full histories, or their ability to access more information quickly when faced with gaps in their knowledge that can be resolved immediately. In other words, physicians do not merely “know” biomedicine: they also develop an innate sense about how much knowledge, and what types of knowledge, should be prioritized for their work, and what bodies of information are peripheral. In so doing, physicians instrumentalize ignorance, expertly balancing what must be known and what information might be whittled away.
GENESIS OF THE PROJECT

In this dissertation I present the novel concept of sufficient knowledge. In truth, however, I had no intention in the beginning to focus on any form of non-knowledge in medical education. While the methods of this project remained largely unchanged from my initial research design, I initially planned to study the relationship between professional role performance and certainty in medical training: put another way, how medical students learn to act and appear certain. While other scholars (Sinclair 1997) have examined certainty and role performance, I was particularly interested in the way the material and spatial environments of training served to alter and reframe the way that medical students enacted their performances of certainty to patients and to one another.

For instance, my original research plan posed the questions: how do medical students learn the proper use of tools? When does the use of medical instruments undermine or cement the certainty that a physician portrays to others? How does the material and spatial boundaries of the clinic impact the way physicians' certainty is cued to other? Drawing from Bruno Latour’s actor-network theory (Latour 2007), I sought to ethnographically map the ways that physicians-in-training are socialized to act and enact their roles through material objects. I also aimed to connect this material analysis to the expansive body of anthropological and sociological literature on competence and mastery in biomedical practice, which I will outline in the next chapter.

Though I intended to study certainty, my time in the field presented me with new data that I could not account for, and that challenged me to investigate
non-knowledge instead. Three months into observations, I noticed that my medical student participants made frequent comments that suggested uncertainty—and as I would later find, ignorance—was not always problematic. “It’s always helpful to not know something,” a second year medical student told me. A first year student said, “uncertainty can be encouraged and be okay.” Her peer told me, “[medical school] is the best place to not know something.” In the hallways between classes and over discussions at the cafeteria during lunch, medical students spent far more time chatting about what they didn’t know than what they did. They talked about the topics they overlooked in their weekly reading, the questions they missed on exams, and the concepts and formulas that confused them.

Having familiarized myself with the work of Renée Fox (Fox 1957, 1980, 1998) I knew that uncertainty had been identified as a core theme in medical students’ experiences training. Yet the language that medical students used around not knowing was distinct: they spoke of *using* uncertainty, of deciding not to know, and of ignoring information of their own accord. This was decidedly not the psychological anxiety over the scientific unknown that Fox described, though the medical students I spoke to indicated that they had, at points, felt uncertain: they felt unsure about their decisions to pursue medicine, worried about their ability to succeed academically, and expressed doubt about their future in the medical profession. Instead, what the students were detailing to me was a separate, productive, and thoughtful relationship with non-knowledge that I
couldn’t initially place in the landscape of the existing literature on medical education.

As I pondered these exchanges, I reflected back onto memories of my own father’s medical knowledge. Despite many years of training as an interventional cardiologist, he hesitated to dispense advice on common illnesses. “Take a Tylenol and drink some tea,” he would tell my brothers and I, no matter if our illness was a fever or a cough, a sniffling nose or a sore muscle. If we had the misfortune of an upset stomach, the mantra received an extra line: “Take a Tylenol, drink some tea, and eat dry crackers.” My brothers and I were baffled that our dad could treat patients’ hearts by placing new valves in them, and carefully scope their arteries, but not cure our fleeting colds and flus. “Unless you’re dying of a heart attack, your father can’t help you,” our relatives would tease, “He’s a heart plumber.”

Throughout my own graduate education, as I was tasked with mastering wide swathes of literature in my discipline, I could scarcely shake those memories from my mind. *How do you become an expert and not know things?* I wondered, though it never occurred to me earlier to study this. But through ethnographic research, it became increasingly clear. My dad knew what he needed to know: how to fix ailing hearts (and, it seems, how to deftly avoid diagnosing his own children.) Indeed, even after writing my own extensive comprehensive exams that reviewed key literature for my doctoral candidacy, I could not claim to know everything in my fields of study, even though I knew enough of the shared methods and theories that fellow medical anthropologists
outside of my subfield also drew upon. As one scholar (Nowotny 2017) observes, this type of uncertainty—of confronting, acknowledging, and then responding to these gaps in understanding—is what drives the production of scientific knowledge and practice. Thus even amongst “knowing” experts, non-knowledge plays an important part in delineating and rendering knowledge from ignorance.

In reflecting back upon the data that I collected and now present in these pages, I found one metaphor particularly compelling for thinking about this relationship between knowledge and ignorance in the creation of sufficient knowledge: the metaphor of stamp artwork. To create a stamp, an artist must take a full block of rubber and carve away the rubber until an image emerges in relief. The artists thereby create an image by removing material: in fact, without carving this material away, there would be no image at all. Physicians who generate sufficient knowledge operate in much the same way as a stamp artist. He, she, or they uses strategic ignorance to pare down what can be left unknown so that a clearer understanding can arise out of this epistemological process. Furthermore, as every stamp image requires the artist to carve out different patterns in the rubber, so too do physicians parse out what knowledge is not needed for individual cases that require unique understandings of the context and progression of an ailment or injury.

As I will explore in the ethnographic chapters of this dissertation, contemporary medical students know how not to know: they know what information to carve away, and what concepts to bring into focus. They are exacting and thoughtful about how to manage and make use of an endless and
unwieldy body of scientific information. Having shifted the focus of this research from certainty to uncertainty, and uncertainty to ignorance, I will argue that when medical students at Midwest School of Medicine spoke favorably about not knowing, they were not championing total ignorance: instead, they were underlining the significance of acquiring and applying knowledge in a more productive, manageable way. In the next section, I will provide an outline of this dissertation and an overview of the chapters that culminate in an ethnographic portrait of sufficient knowledge.

OUTLINE OF CHAPTERS

In Chapter 1: Literature Review, I will assess three bodies of interconnected scholarly work on medical and scientific learning and practice. These fields include the anthropology and sociology of biomedical training and practice, science and technology studies (focused on sociologies of scientific knowledge or SSK), and agnotology, the interdisciplinary study of ignorance. Principally, this dissertation situates itself within the first two bodies of literature by serving as a corrective to the overabundance of literature on knowing, and not on ignorance or the relationships between non-knowledge and knowledge. Reflecting back on both the data I collected and my own training as a graduate student, the claims that experts don’t know everything and choose to know some things over others is scarcely a radical one. Yet despite how obvious this statement may feel, conscious and useful ignorance is an epistemological object that is largely missing from the social scientific record. By drawing on the emergent field of agnotology, this dissertation seeks to refocus the ethnographic
lens on typologies and explorations of ignorance beyond the previously identified phenomenon of medical uncertainty.

The next part, Chapter 2: Methods and Field Site, opens with a description of my study site and a consideration of “studying up” (Nader 1969) in relation to my role as an ethnographic researcher in a medical school setting. In this chapter I overview student demographics, offer an outline of the curriculum, remark on key gatekeepers at the site, and note numerous key features that characterize my field site. I then discuss the methods I implemented for this project, and discuss the study design’s rationale. As I will explain in further detail in Chapter 2, this project was based on fourteen months of fieldwork from March 2017 to May 2018. From this project, I draw on data derived from both semi-structured interviews with students and faculty as well as classroom observations with first and second year medical students. The chapter will also consider the limitations that I encountered when performing this research, and how the design of the project sought to account for the situation at my field site.

Chapter 3: Constructing Sufficient Knowledge is the first of two parts that presents the findings original to this research project. In it, I uncover how student-directed learning in contemporary medical school curricula socializes medical students to independently make decisions about what to know and not know. I begin the chapter with a critical reading of existing scholarship on curricular models in North American medical education, particularly in light of the new findings from my ethnographic fieldwork. This literature also serves to contextualize the curricular model implemented at my field site in conjunction
with broader trends in American medical education. In the subsequent sections, I present my ethnographic findings on both preclinical (first and second year) and clinical (third and fourth year) medical students’ practices of sufficient knowledge. In the first sections, I will describe how the venues of classroom learning and exams and assessments shape my first and second year medical students participants’ expectations about knowing and ignorance. I will also remark on the changes in sufficient knowledge practices that my participants voiced to me through interviews, popular internet memes, and in the classroom. I follow this section with a novel analysis of the local language medical students use to characterize knowledge and ignorance: namely the terms high yield, low yield, and rabbit holes. In the final section, I consider how medical students’ clinical experiences further shape and solidify their understanding of sufficient knowledge, drawing on my interviews with a cohort of fourth-year medical students. This section centers on the themes of “pimping questions” (also observed by Detsky 2009 and Wear et al. 2005), patient case presentations, and other daily practices in the clinic.

In Chapter 4: Factors of Sufficient Knowledge, I draw on further original data to assert that time, teamwork, specialization and granularity, and access to technology and resources alter what choices are made to know and ignore medical information. My findings throughout the section indicate that sufficient knowledge is not produced in an epistemological void. The material and practical constraints around medical practice impact how much can be known and what must be ignored in delivering patient care. In this section, I will argue that my
medical students’ experiences in both the classroom and clinical spaces align with actual clinical practice. I have found these early training experiences to be highly indicative of the epistemological quandaries that are present in later physician practice, and therefore are deserving of future ethnographic attention. Upon describing the data that relates to this series of factors, I conclude that even the earliest stages of medical training are critical if social scientists hope to understand the decisions physicians learn to make around knowledge and ignorance.

Next, Chapter 5: Implications of Sufficient Knowledge will expound upon the significance and applicability of my framework to a series of distinct fields: the anthropology and sociology of biomedicine, epistemologies and agnotologies of science, bioethics and clinical ethics, and medical education. Regarding the first two disciplines, I will argue that sufficient knowledge presents a novel way to map the relationships between knowing and not knowing. I also underscore the value of the ethnographic lens for the study of knowledge practices, ignorance, and knowledge socialization in scientific communities. This dissertation project may also offer new perspectives for the fields of bioethics and clinical ethics. I posit that while thoughtfully limiting knowledge may aid physicians by winnowing a large body of medical information, this process may cause physicians (and indeed, other clinicians) to overlook symptoms, to misdiagnose a patient, or to fail to respond to patients’ concerns if they do not align with the clinician’s. Put another way: what happens if physicians make the wrong decisions about what to ignore, or focus on information that proves to be unnecessary? The section will
end with a discussion of the implications of my findings to medical educators. The dissertation will conclude with a final chapter summarizing the key arguments from each section. It will likewise contain a call for future work that might be undertaken on the themes of ignorance, uncertainty, and non-knowledge in the anthropology of biomedicine.

SUFFICIENT KNOWLEDGE IN CONTEMPORARY AMERICAN BIOMEDICINE

Throughout this dissertation, I draw on both primary ethnographic data and secondary social scientific and educational data to illustrate how sufficient knowledge arises in contemporary medical education and practice. I argue that sufficient knowledge does not occur in an epistemological or social void; it is produced both in the local environments of training and practice that are at the center of my ethnographic work, and within the larger institutions of American biomedicine, managed care, and the medical profession. Here, I would like to preface the remainder of this dissertation with a brief discussion of the structures under in which American physicians learn and practice. I seek to underline these contexts and the ways in which they give rise and form to strategic knowledge, conscious ignorance, as well as the dynamic relationships between knowledge and ignorance.

As I outline in greater detail in Chapter 3, the curricular structure of contemporary medical education is one mechanism through which sufficient knowledge arises in modern American biomedicine. I will not belabor this analysis here, but it is suffice to say that medical students are increasingly trained in student-led, problem-centered curricula where they are explicitly
challenged to make decisions around the course of their knowledge
development. At my field site, students were enrolled in a course that met three
days per week where they were expected to self-direct their study. Students were
given written case narratives that described a mock patient’s symptoms, lab
values, diagnoses, treatments, and prognoses. Students would then be asked to
study the relevant organ systems, chemistry, biology, physics, anatomy,
pharmacology, microbiology, and ethics, amongst other fields, that would explain
why the patient experienced illness and the etiology of his, her, or their
complaint.

The popularity of these types of courses, as reported by the AAMC (2013, 2016)
suggests that the newest cohorts of physician graduates are progressively
more conscious of the limitations they must place around their knowledge.
Indeed, the courses themselves are intended to prepare physicians to be adept
and thoughtful problem-solvers who can independently navigate complex
medical cases and their subsequent interventions. As I explore in both Chapter 3
and Chapter 4, these limitations might arise due to gaps in a patient’s medical
history. Students also learn that knowledge requirements differ in various
assessment and learning venues, such that information that would be highly
relevant and pressing to know for one setting—such as in an exam—may not be
as pressing in another venue, like in outpatient clinics. In these courses, students
also begin to study the material and social constraints placed around physician
practice. They learn that practitioners do not have unlimited time or resources to
resolve patient problems, and that sometimes these factors alter what can be known about and subsequently done for the betterment of the patient.

In Chapter 4, I also gesture towards the role that the institutional structures of healthcare play in determining sufficient knowledge practices. As this dissertation focuses primarily on undergraduate medical education, I have abbreviated the discussion of physician practice in the aforementioned chapter. However, it is important to understand how the structural environment of American healthcare presents its own set of conditions that catalyze sufficient knowledge. Some of these variables are described explicitly by my participants and included in Chapter 4. Others I briefly describe here in order to situate my findings for fellow ethnographers and social scientists, particularly those who wish to assess sufficient knowledge in the later practice years or in residency and fellowship training. These dimensions principally include managed care and the changing authority of physicians as medical caregivers.

Managed care is the practice of outsourcing the organizational and administrative structuring of clinical practice, such that physicians provide care to patients but have little individual authority over the third-party transactions that occur between patients, hospitals, and insurance networks. This brokering occurs largely beyond physicians’ control, unless patients are paying physicians directly within less common fee-for-service practices. My participants complained at length about the bureaucratic difficulty of providing care in an environment where they felt that they had diminished professional freedom. They particularly mourned their subservience to administrative codes that demanded higher output
and less time spent with patients. As I indicate in Chapter 4, time was perhaps the most important factor that limited the scope and depth of knowledge that physicians and medical students could develop and implement in patient cases. If a physician or medical student is only given a limited amount of time with a patient, it is not possible to develop complete knowledge of his, her, or their medical, social, and personal histories.

A related factor consists of the constraints placed around material resources available to physicians to treat patients. Hospital systems might fail to invest in an expensive diagnostic machine if other, less expensive technologies could be substituted, even if these tools produced less information about a patient’s well being in the eyes of physicians. Specialization and teamwork, the other two factors I describe at length in Chapter 4, are also products of a managed care system: where treatment is meticulously ordered, care is divided amongst specialists. Primary care interventions and the day-to-day management of illness is relegated to the least costly physician specialists, or to other general practitioners and clinicians, making the transfer of information between specialists through consultation essential.

In a further effort to create systematic and digestible accounts of patients’ overall wellness and treatment trajectories, physicians in managed care settings must maintain electronic health records (EHR, also known as electronic medical records or EMRs) for each patient. The goal of the EHR is to reduce lost paperwork and to make records more easily transmitted between physicians who provide treatment in the same care networks, in addition to providing a more
detailed longitudinal record of patients’ health. In practice, however, EHRs constrain the types and format of information a physician is able to meaningfully gather in patient interactions. Data that fit into the EHR system become known, while other data that is not as easily formatted for the system may be reframed or ignored entirely. As I comment later in this dissertation, both my physician and medical student participants were quick to assert that EHRs habituated them to the necessity of foregoing some information over other information, as determined by the system. Thus, when interfacing with managed care infrastructures and the technological systems that support them, physicians are sometimes required to make decisions that limit knowledge, or at least curtail its utility and application.

There are, of course, cultural shifts beyond managed care that impact the epistemological relationships between physicians and their patients. Patient advocacy movements have mobilized the public, leading to demands of greater transparency and more decision-making authority for patients and their caregivers. Increased access to medical information online, while potentially detrimental to patient literacy when sources are unreliable, has also positioned patients to have a higher degree of knowledge on their diagnoses, symptoms, and medications than in past generations. It is not true that all patients wish to become equal partners in their medical care, and more patriarchal models of biomedical treatment certainly remain. For those patients who do wish to enter into therapeutic relationships where there is greater collaboration, though, there is decreasing space for physicians to practice as omnipotent experts. To be
transparent, often to preemptively avoid malpractice suits, physicians need to verbalize the limitations of their knowledge; to be an equal therapeutic partner, they must recognize when the symptoms and lab results that they prioritize might not match a patient’s concerns for his, her, or their treatment agenda. In these ways, contemporary patient advocacy movements have situated physicians to be more forthcoming and deliberate about the choices they make around what to know and what to ignore within patient care scenarios. These are but a few of the numerous structural-level factors that position American physicians towards sufficient knowledge, and which are reflected in my ethnographic data.

SUFFICIENT KNOWLEDGE: MAKING “BETTER” PHYSICIANS

In considering these larger questions about the professional environment of American biomedicine, we might ask an equally sweeping question about physician practice. Does the process sufficient knowledge, and the sorting of knowledge based on utility or lack thereof, produce “better” physicians? As I argue in Chapter 5, it is certainly true that by engaging in sufficient knowledge practices, medical students learn to be more decisive, more thoughtful, and more wary of the boundaries of their own knowledge. In my experience, early confrontations with the limits of knowing encourage medical students to be more humble, more observant, and certainly more realistic about their ability to resolve patient problems. This may be the most telling sign that student-led learning in modern American medical education is indeed producing the critically-minded physicians who are able to provide high-quality patient care.
Yet as I also note in Chapter 5, ignorance—conscious or unconscious—can also put patients in the way of medical risk and endanger the trust between physicians and their patients. Put simply, as ethnographers commonly do: it depends. Sufficient knowledge as a decision-making framework has the potential to make physicians more effective, more conscious caregivers. It can also lead to gaps in knowledge that have real implications for patient safety and well being. I find that my colleagues in clinical ethics and bioethics are especially adept at considering these ramifications of sufficient knowledge. With the future collaboration of ethicists, I hope that we will produce better guidelines and educational models for medical students, ones that directly steer medical trainees clear of the perils of ignorance and strategic knowledge. First, however, we must generate the kind of experience-near, qualitative data that can illustrate how, what, and when sufficient knowledge occurs in medical education and practice. This dissertation serves as one descriptive account of ignorance that strives to foreground conversations about the benefits and pitfalls of strategic choices to know and not know in biomedicine.

SUMMARY

This dissertation explores the concept of sufficient knowledge: the notion that to develop “enough” of a working understanding of an object of practice or analysis, one must make conscious decisions around what forms of information to include and exclude. The resulting epistemology is one of prioritized knowledge that is sufficient for the purposes of its application. As I commented earlier, trainees, experts, and academics alike all make these choices around
what to know and what to ignore. I will illustrate how medical students’ decisions to know and ignore information are socialized in early training, and discuss why this process matters to our understanding of later-stage physician practice. As I will suggest throughout this work, the phenomenon of sufficient knowledge is particularly evident in medical education, but the concept has utility across anthropology and sociology of science as well as bioethics. Physicians-in-training must contend with an enormous body of scientific knowledge, which cannot be mastered in its entirety.

The dissertation’s central contribution to the field of anthropology and its neighboring disciplines is the notion of “sufficient knowledge.” As I have stated throughout this introduction, sufficient knowledge is the process and product of conscious choices to ignore or know information based on its perceived utility or applicability to problems. Through close analysis of my ethnographic data, I show that medical students choose what to know and what not to know for the purposes of the clinical cases that they analyze. Factors such as specialization, time, teamwork, and resources—as I will later describe—impact and direct this process in various ways. My dissertation will draw widely from literatures in anthropology, sociology, science and technology studies, and the nascent field of “agnotology” or ignorance studies to frame the discussion of knowledge in existing scholarly works. I will situate my own findings within these literatures throughout the dissertation.
Chapter 1: LITERATURE REVIEW

INTRODUCTION

This dissertation engages with three bodies of academic literature: the anthropology and sociology of (bio)medical education and practice, science and technology studies (specifically, social constructions of scientific knowledge), and agnotology or the theoretical study of ignorance, also termed “non-knowledge.” Each literature informs different, though highly interrelated, facets of the principle of sufficient knowledge amongst future physicians. As I will argue here, the ethnographic focus on sufficient knowledge—and allied forms of not knowing—serve as a corrective to an overwhelming body of literature in medical anthropology and sociology on mastery, certainty, and control in the medical profession. This work also seeks to expand upon the work of Renée Fox, who pioneered the study of medical uncertainty, by describing a new way in which ignorance or non-knowledge factors into the day-to-day experiences and ultimate socialization of contemporary medical students.

This dissertation likewise engages with the fields of science and technology studies and agnotology, or the interdisciplinary study and theory of ignorance and non-knowledge. Specifically, it draws from theories of the social construction of scientific knowledge and from the field of sociology of scientific knowledge (SSK) while expanding these fields to include forms of non-knowledge in the ethnographic analysis of science-in-action. Here this project unites STS with agnotology, an interdisciplinary approach to the critical study of ignorance and other forms of non-knowledge. By threading together the sociology of scientific knowledge with approaches in agnotology, this dissertation
argues that scholars are better able to locate places where scientific knowledge—rather than solely being disseminated or transmitted—is also limited, bounded, and framed through ignorance. This literature review will begin with a topical discussion of the anthropology and sociology of medical education and biomedical practice, and then shift into an overview of the field of science and technology studies (focused on anthropologies and sociologies of scientific knowledge) and the space for agnotology within the social construction of knowledge via the premise of sufficient, prioritized knowledge.

ANTHROPOLOGY AND SOCIOLOGY OF MEDICAL EDUCATION AND PRACTICE

There is a long-standing tradition of anthropological and sociological work on medical education and practice, particularly within the United States. Though there have been numerous anthropological accounts of medical education and clinical practice (see (Fox 1957, 1980, 1998), much of the qualitative research on medical education has been done within the field of sociology. That said, sociologists of medical education have commonly adopted ethnographic and qualitative methods from medical anthropology to take a person-centered, experience-near approach to the study of medical training (Haas and Shaffir 1977; Sinclair 1997; Luke 2003; F. W. Hafferty 1991; Underman 2011, 2015; Vinson 2018). The anthropology of biomedicine is itself an expansive field; thus, in this section, I will specifically address the theme of knowledge in anthropologies and sociologies of medical education and physician practice. In the second section on science and technology studies, I will return to
anthropologies of biomedicine more generally to consider how this body of literature engages with social constructions of scientific knowledge.

In this section, I will argue that the social science of clinical training and practice has focused widely on knowing, and the many forms that it takes. However, much less literature has examined the theme of not knowing in medical education and practice, with a limited body of literature and physician commentaries on one form of non-knowledge: uncertainty. This dissertation project seeks to correct the gap in the literature by demonstrating that contemporary American medical students intentionally, thoughtfully, and productively limit and frame their knowledge. In the forthcoming ethnographic chapters, I will assert that this process of sufficient knowing is both a previously unidentified form of non-knowledge in medicine, as well as an intellectual space in which knowing and not knowing are mutually productive.

EARLY RESEARCH AND UNCERTAINTY

The existing literature in medical social science has widely emphasized knowing rather than not knowing or the limitations around knowledge, having centralized on the themes of competence, expertise, and skill (as I will discuss later in this section.) The focus on knowledge began with two foundational works in the social science of medical education: Boys in White: Student Culture in Medical School and The Student-Physician: Introductory Studies in the Sociology of Medical Education (H. S. Becker et al. 1976; Robert King Merton 1957). These early works did not seek to question the cultural embeddedness of Western scientific medical practice (Hahn and Gaines 1984; Gaines and Davis-Floyd
2003), the way that professional structures within and around science altered the nature of biomedicine (Starr 2017; Brown 1981), or the history and development of medical education across national contexts (Rothstein 1987, 1972; Bonner 1995; Ludmerer 1999). However, Becker, Merton, and their colleagues did open medical education in North America to sociological and anthropological exploration, sparking a continued interest in the social study of medical training (Brosnan and Turner 2012).

During this initial era of social scientific research on medical education in the 1950s and 1960s, Renée Fox spearheaded her studies of uncertainty in medical training and practice. Fox demonstrated that physicians and physicians-in-training faced uncertainty in a variety of forms (Fox 1957, 1980, 1988, 1998; Fox and Swazey 2002). For one, Fox found that physicians inevitably experienced uncertainty due to the limitations of current scientific knowledge. Without scientific knowledge on a disease process or groundbreaking treatment, she found, physicians had to contend with uncertainty by providing the most appropriate treatment and finding ways to articulate gaps in the scientific literature to their patients and one another. On the other hand, Fox noted that physicians are confronted with such an enormous volume of scientific and technical knowledge as they enter practice that it would be impossible for them to know it all and command perfect mastery of their work; likewise, a physician may have gaps in his, her, or their knowledge that they are unsure is caused by their own lack of understanding or by missing knowledge in the scientific literature (see also Kerwin 1993; Witte, Kerwin, and Witte 1988; Witte M. H. et al. 2009). A
series of critiques from Fox’s colleagues (D. Light 1979; Atkinson 1984) argued against the uncertainty premise, asserting that physicians are trained to know and respond effectively to ambiguous disease presentations.

In spite of these critiques, uncertainty remained the focus of many future studies on medicine and biomedical practice. Spurred by Fox’s work, psychologists and sociologists of medicine have identified that physicians may develop “tolerance to uncertainty” or tolerance to ambiguity that is inherent to clinical practice (Gerrity et al. 1992, 1995; Sobal and DeForge 1991; Strout et al. 2018). Medical sociologists and anthropologists have likewise explored the theme of uncertainty. For instance, Leibing (2009) found that physicians in Brazil resisted uncertainty in the usage of Alzheimer’s medications by widening the scope of what they considered to be efficacious treatment results. Physicians who work with patients with autism (Fitzgerald 2017), physicians treating encephalopathy (Rasmussen et al. 2018), patients recovering from strokes (G. Becker and Kaufman 1995), and patients at the end of life (S. R. Kaufman 2015, 2006) similarly experience uncertainty over prognosis and diagnosis of these dynamic conditions. Other social scientists have found that even in an era of medical documentation and evidence-based practices (Timmermans and Angell 2001; Timmermans and Berg 2003; Street 2011, 2014) uncertainty and ambiguity continue to permeate the interpretation and treatment of disease within biomedical systems, and that standardization cannot always account for unclear illness trajectories or missing patient histories.
Within the realm of medical education, scholars, physicians, and medical students alike have noted that uncertainty is a common experience. Holmes and Ponte (2011) discovered that medical students were trained to curb uncertain language from their patient case presentations. Suzanne Poirer’s analysis of medical student memoirs (Poirier 2009) describes the common metaphor of drinking “water from a fire hose.” Medical students use this phrase to express concern and frustration about learning an endless volume of medical knowledge that continues to change as scientific research changes understandings of human biology and disease. This process inevitably renders medical students uncertain of some dimensions of biomedical knowledge, regardless of how committed students are to learning and studying. Medical students and physicians themselves have reflected on the theme of uncertainty in learning and practice within the academic literature. Commentaries on medical uncertainty have appeared in the *Journal of the American Medical Association* (*JAMA*) (Campbell 2014), the *New England Journal of Medicine* (*NEJM*) (Hunter 2016; Raiten and Neuman 2012; Simpkin and Schwartzstein 2016), the *British Medical Journal* (*BMJ*) (Hatch 2017; Kimbell et al. 2016), and elsewhere (Jha 2015; Kay 2017; Katz 1984). While these authors focus on uncertainty and ambiguity above other forms of non-knowledge (such as ignorance, which I will address below), it is evident that physicians and medical students are not socialized or trained strictly for knowledge and certainty.
Though there is an established tradition of studying uncertainty within biomedicine, the better part of ethnographic and qualitative research on medical education and practice has emphasized knowing, mastery, and competence over the theme of uncertainty or not knowing. Studies on medical students’ experiences from the 1950s to the present demonstrate that physicians-in-training have been perennially concerned with how much they must know and how to instrument that knowledge (Becker et al. 1976; Montgomery 2006), what concepts they will be tested on (Becker et al. 1976; Coombs 1978; Coombs 1998) and how to appear competent and develop “competence” (Mary-Jo DelVecchio Good 1995; J. M. Metzl and Hansen 2014; J. M. Metzl, Petty, and Olowojoba 2018) even when they do not know (Haas and Shaffir 1977; Haas Jack and Shaffir William 1982; Sinclair 1997). Literature on the experiences of physicians and medical students has similarly addressed other dimensions of medical knowledge, including:

(1) Knowing how to respond affectively to patient encounters through medical, technical, and narrative practices (F. W. Hafferty 1991; Underman 2011, 2015; Mattingly 1998; Charon 2006; Arthur Kleinman 1989)

(2) Knowing cultural competence and cross-cultural care delivery (Arthur Kleinman and Benson 2006; Taylor 2003a, 2003b)

(3) Embodied knowing of the techniques of surgery and medicine (Prentice 2005, 2012; Fountain 2014; Johnson 2007, 2008) and
knowing how to visualize and interpret the biomedical body (B. Good 1994; Saunders 2008)

(4) Knowing how to effectively deliver medicine in resource-limited, developing (Finkler 2001) and postcolonial settings (Brada 2011; Wendland 2010, 2012; Mckay 2012; Street 2011, 2014; Benton and Atshan 2016)


(6) Multiplicities of physician knowledge and biomedical pluralism (Berg and Mol 1998; Mol 2003; Hahn and Gaines 1984; Gaines 1992)

Outside of medical education and physician practice, other anthropological work on allied health professions has similarly considered the construction of biomedical knowledge, and how training imparts particular forms of medical knowledge within a range of national and technological contexts. This includes a seminal body of research on training and practice in the fields of global midwifery (Hildebrand 2012; Hsu 2001; Maupin 2008), genetic counseling (Franklin and
Roberts 2006; Rapp 2000, 2009), and occupational therapy (Mattingly 1998). In sum, the sociological and anthropological discussion of clinical education and medical practice are dominated by a focus on knowledge and knowing, in a variety of forms. This literature eclipses the more limited research on not knowing and uncertainty: albeit both bodies of work are key perspectives within the social science of medicine.

SUFFICIENT KNOWLEDGE: EXPANDING BEYOND KNOWLEDGE AND UNCERTAINTY

Though these conversations about medical knowledge and uncertainty are inarguably valuable, they both overlook the reality that physicians engage in forms of non-knowledge beyond diagnostic or scientific ambiguity. This dissertation aims to advance the discussion of non-knowledge in medical education and practice by describing the new phenomenon of sufficient knowledge. A sufficiently knowledgeable physician is one who has developed a keen sense of what types of knowledge are needed in different clinical situations, how and where to obtain them, when to have specialized knowledge (or who to defer to for specialized knowledge), and what knowledge to prioritize given the limit of time in the medical setting. In other words, the sufficiently knowledge physician knows when not to know, and when to seek out certain forms of information over others. His, her, or their non-knowledge is not ambiguous, but intentional and purposeful, allowing the physician to address medical problems with a keen awareness as to what forms of information are necessary and which pieces of knowledges are periphery and can be set aside. This dissertation does not seek to supplant the discussion around uncertainty: indeed, given the
unlikelihood of complete scientific knowledge and the impossibility for any one physician to “know it all,” there will always be biomedical uncertainty. Instead, this dissertation seeks to explore intentional and productive ignorance in the training of medical students.

SOCIAL CONSTRUCTIONS OF SCIENTIFIC KNOWLEDGE: SCIENCE AND TECHNOLOGY STUDIES

This dissertation takes a social constructionist approach (Gaines 1998; Delvecchio Good 1995; Holstein and Gubrium 2008) to the study of medical knowledge and ignorance, which is rooted most centrally within the fields of science and technology studies (STS) and cultural studies of science (CSS.) In this section, I will begin by defining “social constructionism,” STS (S. Cutcliffe 2000; S. H. Cutcliffe 2001; Sismondo 2009) and CSS (Gaines 1998). I will then assert that these fields have long focused on the study of scientific knowledge, specifically the way scientific knowledge is “made” or constructed under different cultural, political, social, economic, and ethical conditions. Beneath the umbrella of STS, this body of work is commonly referred to as the “sociology of scientific knowledge” or SSK (Collins 1983), which is dovetailed by the field of “the sociology of scientific ignorance” or SSI (S. H. Stocking and Holstein 1993; H. S. Stocking 1998). These terms are misnomers, as I will highlight how anthropologists of science and medicine have contributed significantly to the social study of science, especially through the contribution of ethnographic methods to laboratory studies and other qualitative investigations of science. The section will end with a discussion of how this dissertation work seeks to expand STS literature by: (1) drawing on empirical findings to illustrate how knowledge
and non-knowledge are mutually constructed, and not opposed, and (2) contributing to a growing literature on the sociology of scientific ignorance (SSI), which complements SSK.

SOCIAL CONSTRUCTIONISM AND THE FOUNDATIONS OF STS AND CSS

The theoretical nucleus of both cultural studies of science (CSS) and science and technology studies (STS) is *social constructionism* (Hacking 1983, 2000; Gaines 1998; Delvecchio Good 1995). Social constructionism is a theory of knowledge stating that all knowledge is contextual: that is, what becomes accepted reality and truth depends on who is generating that information, who is receiving it, and who is implementing it, and under what social or environmental conditions. Put another way, social constructivists hold that scientific knowledge is not singularly objective (Daston and Galison 2010) but rather develops in response to particular worldviews and social pressures. Kuhn (2012) and Popper (Popper 2002a, 2002b) were foundational authors in the philosophy of science who demonstrated that scientific knowledge is not divorced from social context, and indeed that the production of new scientific knowledge depends on when, how, and where a scientific development occurs.

The sociology of scientific knowledge (SSK) arose out of this intellectual milieu (Shapin 1995; Shapin and Schaffer 2017; Collins 1983) as social scientists sought to dismantle the divide between the “natural” world (i.e. scientific reality) and the “social” world (i.e. lived, subjective experience) by demonstrating how scientific activity is framed and directed within social structures. Latour and Woolgar’s *Laboratory Life: The Social Construction of Scientific Facts* (Latour
and Woolgar 1986) and Latour’s *Science in Action: How to Follow Scientists and Engineers Through Society* (Latour 1988) soon became prominent early examples of ethnographic investigations into science. These texts underscored the importance of observing and recording scientific work empirically to uncover how scientists within their professional cultures come to conclusions about their findings, and why they might turn away from alternative explanations or experimental models. Cultural studies of science (CSS) similarly suggests that science is a product of the culture in which it is produced (Franklin 1995; Martin 1998) though it differs from STS in that CSS is more focused on cross-cultural heterogeneities of scientific knowledge and the impact of local culture, practices, and beliefs on science. STS scholarship tends to focus on the internal practices and values within the profession of science that create and shape new knowledge (Rouse 1993).

**THEORIES IN STS: EPISTEMOLOGY AND SOCIAL CONSTRUCTIONS OF KNOWLEDGE**

Like the sociology of medical education and practice, STS has similarly emphasized the construction of knowledge over the genesis of ignorance. The field has examined knowledge in a variety of ways. Some theorists have emphasized the materiality of science and technologies, particularly the ways in which non-human entities such as specific tools and the physical or natural environment shape human action and produce new knowledge (Latour 1993, 2007; Barad 2003, 2007; Bennett 2010). Other scholars have considered how technologies themselves gain social and symbolic meanings that alter their use and the behaviors of those who employ them (Bijker and Law 1994; Volti 2013).
Feminist science scholars have examined how scientific knowledge is gendered and how science perpetuates systems of oppression on women’s lives (Haraway 1990, 1996; Fausto-Sterling 2012) and women’s voices in science (Harding 1986, 1991, 2008, 2015; Keller 1996). Though these scholars do not directly study ignorance, their work does illuminate how women’s voices are silenced or displaced from the production of scientific knowledge, thus creating gaps in scientific understanding. Other scholars have examined the socio-political relationships between scientific knowledge, public understanding, and nation building in North American, European (Jasanoff 2004, 2007, 2016), and Asian (Ong 2016) global contexts, as well as public ignorance or misreadings of science (Ungar 2000, 2008). Each body of theoretical work described here seeks to understand the ways in which scientific knowledge is given meaning, significance, and power, and how science as an institution interacts with gender, politics, and the environment. While there is some attention paid to ignorance and non-knowledge in these accounts, and there is an emergent sociology of scientific ignorance (SSI) that I will describe shortly, the theoretical discussion in STS and CSS is focused primarily on epistemology and its relationship to scientific practice and technological development.

Another, related body of social constructionist theory in STS seeks to analyze the ways in which scientific knowledge itself is comprised of a series of knowledges across different social actors: in sum, how people with stakes in a particular science or technology perceive, utilize, and understand it differently than other individuals who might interface with that knowledge or tool. Scientific
reality, then, is in fact the amalgamation of the many knowledge relationships that distinct parties have with the science or technology at hand. Mol has examined the multiplicities of biomedical knowledge between practitioners, using the ethnographic case of atherosclerosis in a Dutch hospital to examine how different medical specialists, clinicians, and patients each envision and experience the same biomedical disease category (Mol 2003). John Law has also explored how one technology, a World War II-era aircraft, was “fractionally coherent” given the ways that numerous stakeholders—from scientists, to government officials, to the public—received and responded to the aircraft and its development in their own ways (Law 2002). Together, Law and Mol have undertaken other studies of how knowledge of scientific objects (including disease entities) differs depending on who is interacting with the objects and how (Law and Mol 1995, 2007). Law and Mol acknowledge that there are many variations in the ways that scientists and the public, and clinicians and patients, “know”. Though Law and Mol still emphasize knowledge over non-knowledge, they recognize the inherent gaps, fissures, and variations in understanding between individuals that, in sum, form accepted scientific and biomedical knowledge. As I will argue later in this dissertation, Law and Mol’s work is echoed in the way that physician specialists and medical students with different areas of expertise bring their own knowledges (and ignorances) into practice and training as participants in a multi-professional clinical team.
Beyond the core theoretical work of STS and CSS, there is also a substantial topical literature in the anthropology of biomedicine that similarly holds that medical science and technologies are embedded in the social-cultural contexts of their development and use. These works demonstrate the significant overlap between biomedical anthropology and the interdisciplinary field of science and technology studies. Most especially, contemporary anthropologists of science and technology actively apply the ethnographic lens to biomedicine and biotechnologies (Burri and Dumit 2007; Downey and Dumit 1998) to assess how science shapes illness experience, medical practice, and conceptualizations of the body. In the realm of medicine, anthropologists of biomedicine have studied topics spanning biological citizenship (Petryna 2009, 2013; Rose and Novas 2008), contemporary molecular biotechnologies (Rabinow 1997; Rabinow and Dan-Cohen 2006), surgical simulators (Prentice 2005, 2012), pharmaceuticals (Martin 2009; Dumit 2012), reproductive technologies (Rapp 2000; Franklin and Roberts 2006; Franklin 2013; Inhorn 2015; Hildebrand 2012), and biomedicalization or the transformation of illness and the body into objects of biomedical inquiry (Clarke et al. 2010; Conrad 2007). These projects do not only consider personal narratives within biomedical systems, but also the material, symbolic, and biological impacts of science and technology upon human experience. While these anthropological accounts of biomedicine and other qualitative projects have at times examined patient and practitioner uncertainty (Littlewood 2007; Steffen, Jessen, and Jenkins 2004; Henwood et al. 2003), most
accounts nevertheless emphasize the social construction of knowledge across health, disease, and cultural contexts of practice.

STS AND THE SOCIOLOGY OF SCIENTIFIC IGNORANCE (SSI)

A smaller, interdisciplinary contingent of scholars in STS has increasingly begun to study the ways in which ignorance and other forms of non-knowledge are developed and given meaning within scientific research, public conceptions of science, and in the development and utilization of new technologies (Smithson 1993; H. S. Stocking 1998). This field of work has been deemed the “sociology of scientific ignorance” or SSI (S. H. Stocking and Holstein 1993), an intellectual movement that emerged after Merton’s brief analysis of ignorance in scientific practice (Merton 1979) and the 1989 publication of *Ignorance and Uncertainty: Emerging Paradigms* (Smithson 1988). Research on ignorance within scientific research and practice, including on biomedicine, falls within the interdisciplinary called *agnotology* or the study of ignorance and non-knowledge (Proctor 1996; Proctor and Schiebinger 2008). I will detail the field of agnotology, its core concepts, and the relationship of this dissertation project to agnotology in the forthcoming section. However, for now, it is suffice to note that research within science and technology studies has begun to seriously consider the social construction of ignorance and the ways that ignorance and non-knowledge gain social meaning in the sciences, biosciences, and biomedicine.

STS AND CSS: IMPLICATIONS OF SUFFICIENT KNOWLEDGE

The premise of sufficient knowledge that I will outline in the upcoming sections is a meaningful contribution to the fields of STS and CSS in its
expansion of social constructionist literature to the realm of non-knowledge and ignorance. The study design that I will describe in the next chapter (Methods and Field Site) draws widely upon the same ethnographic techniques that other social scientists have employed in laboratory and clinical settings, while utilizing a similar constructivist theoretical framework to examine the ways in which medical knowledge and non-knowledge are co-produced. This project seeks to demonstrate that future physicians—as professionals who learn and subsequently employ scientific knowledge—construct their knowledge by drawing careful boundaries around what knowledge is necessary and useful, and what knowledge can be consciously set aside and under what social conditions. In the final body of literature that I will review, I will discuss how this form of intentional ignorance aligns with existing typologies of ignorance in the field of agnotology.

AGNOTOLOGY, IGNORANCE, AND ANTHROPOLOGIES OF “NOT KNOWING”

The newest body of literature that this dissertation engages with is agnotology or “ignorance studies,” a multidisciplinary field of study interested in observing, identifying, and analyzing the many forms that “non-knowledge” takes in human life (Proctor and Schiebinger 2008). Scholars in the field of agnotology do not use the term “ignorance” in a pejorative fashion, but instead, to refer to a lack of knowledge or a condition of not knowing and the many forms that ignorance might take across situational and social contexts (Japp 2000). This section will describe the genesis of agnotology and then briefly summarize agnotological works between the 1980s to the present, including recent
typologies of ignorance and studies of ignorance and non-knowledge within the specific fields of science and medicine.

The section will also highlight the contributions of anthropologists to the field of agnotology. Within the section on typologies of ignorance, I will argue that my work does the following: first, it expands the language being developed to describe forms of non-knowledge by introducing a new term and empirical data on “sufficient knowledge.” Second, it draws on the concept of “strategic ignorance” to demonstrate that not knowing can be deliberate, conscious, and productive. Third, it bridges agnotology and epistemology by examining the ways in which not knowing and knowing border, inform, and produce one another.

AGNOTOLOGY: THE TURN TO IGNORANCE

This dissertation draws from the emerging field of agnotology (the social study of ignorance) in order to understand “not knowing” not solely as a personal, psychological experience of uncertainty, but rather as a social construction of knowledge, non-knowledge, and especially the limits of knowledge. The field has its first origins of the work of philosopher Michael Smithson, who in the 1980s argued for the importance of studying ignorance, especially within the sociology of science where he argued that the emphasis on knowledge overlooked the ways that society produces ignorance (Smithson 1988, 1993). Within anthropology itself, Murray Last argued even earlier that ethnographers should weigh the value of “knowing about not knowing” (Last 1981) though the field of anthropology continued to emphasize epistemology, as the previous sections have demonstrated. It was not until 1995 when the term agnotology was first
coined and utilized by academics to refer to the interdisciplinary study of the social and cultural construction of ignorance (Proctor and Schiebinger 2008). Proctor and Schiebinger’s text posits that ignorance is not merely an absence of knowledge that is not impacted by social, historical, or political forces: rather, ignorance—like knowledge—is actively generated and characterized within the contexts where it emerges.

This foundational publication was followed by *The Routledge International Handbook of Ignorance Studies* (Gross and McGoey 2015). In this text, the editors and authors also assert that ignorance is socially constructed, and that it can therefore take numerous forms depending on the cultural, ethical, and political dimensions from which it arises. For instance, the editors state that ignorance can be necessary and willing: such as refusing to carry out a research project if that research would be unethical or harmful. They note that ignorance studies also consider the utility of not knowing, and the state of partial or incomplete knowledge. Conversely, the handbook outlines how doubt can be detrimental: for example, through cultivation of doubt and uncertainty to shape human action in ways that expose individuals to harm or exploitation. That said, the authors of this volume are clear that ignorance is not always conspiratorial or the product of bad science, and can in fact be benign if not useful and productive: as this dissertation likewise aims to suggest.

**TYPOLOGIES OF IGNORANCE AND NON-KNOWLEDGE**

In the social scientific and humanistic literature, there are various forms of ignorance that have been identified, ranging from nescience or total absence of
knowledge (Gross 2007), forbidden knowledge that is unknowable because of institutional or ethical constraints (Kempner, Merz, and Bosk 2011), “unknowledge” or the conscious absence of social knowledge (Schick 1999), and public or common non-knowledge, particularly outside expert or scientific communities (Ungar 2000, 2008; Hess 2016). Other works similarly describe a number of forms of ignorance (Gross 2007; Gross and McGoey 2015; Abbott 2010; Elliott 2013) from the ethical right to patient ignorance and not knowing in biomedical practice, to selective knowing and conscious ignorance in agricultural science, and the skill-based ignorance of amateur practitioners. These texts have also considered ignorance as a methodology and practice: which is echoed in Biehl and Locke’s exploration of “anthropologies of becoming” wherein anthropologists cannot always know the futures and pasts of ethnographic subjects in the midst of their lived experience (Biehl and Locke 2017). Scholars have also explored risk as a form of non-knowledge (Boholm 2003; Samimian-Darash 2013; Samimian-Darash and Rabinow 2015; Vitek and Jackson 2008). Even in evolutionary anthropology, geological and physical evidence may be incomplete or fragmented, leaving scholars to contend with non-knowledge particular to the archaeological record (K. Weiss 2012).

Amidst these forms of ignorance, this dissertation proposes a new form of ignorance, which I have identified as sufficient knowledge. This term expands the language available to describe a new type of non-knowledge that is relational to knowledge. Within the typologies of ignorance that abound in agnotology, the concept of sufficient knowledge that I present here most centrally aligns with two
existing typologies of ignorance: intentionality of non-knowledge (Böschen et al. 2006, 2010; Dilley 2010), and strategic ignorance (McGoey 2012b, 2012a), which I will describe below. Both of these types of ignorance are themselves impacted by the mutual, co-productive relationship between knowledge and ignorance (Croissant 2014).

First, sufficient knowledge echoes the notion of the intentionality of non-knowledge (Böschen et al. 2006, 2010; Dilley 2010). As medical students in my study made decisions about what knowledge was adequate for various topics, they simultaneously made conscious decisions about what could be omitted, glossed, or ignored. Similarly, sufficient knowledge parallels the sociological construct of strategic ignorance (Gershon 2000; McGoey 2012b, 2012a) in that choices about what concepts or ideas can be ignored are calculated decisions based on the perceived amount and utility of knowledge needed to approach medical problems. Therefore, as others have suggested (Croissant 2014; Nowotny 2017), knowledge and ignorance can be allied constructs that co-produce one another: though ignorance can be socially produced outside of the context of knowledge as well. Croissant also observes that granularity and levels of knowledge are closely tied to the construction of ignorance, in that one may have broad knowledge but be ignorant of more specific ideas and concepts. Later in this dissertation, I will expand upon this notion by demonstrating how granularity factored into medical students’ conceptions of sufficient knowledge.
AGNOTOLOGY IN ANTHROPOLOGY AND THE SOCIAL SCIENCE OF 
BIOMEDICINE

In recent years, anthropologists have begun to closely examine ignorance from an ethnographic and culturally situated perspective. This research includes work both on medicine and on other aspects of social life; here, we will begin with an overview of the non-medical work on ignorance and non-knowledge in the anthropological literature. There are two key publications on agnotology and the social construction of ignorance within anthropology. The first, *The Anthropology of Ignorance: An Ethnographic Approach*, explores ignorance across cultures and across human experiences: including anonymous almsgiving in Senegal, to forgotten histories in Japanese life narratives, and refusals to know about shamanistic practices in the Amazon (High, Kelly, and Mair 2012). The second text, *Regimes of Ignorance: Anthropological Perspectives on the Production and Reproduction of Non-Knowledge* (Dilley and Kirsch 2015) similarly casts an ethnographic lens on agnotology. The authors in this collection offer a series of ethnographic examples of the social role of ignorance, secrecy, and gaps in knowledge. They posit three research directions for the anthropology of non-knowledge:

(1) To view ignorance as a positive and productive social force that complements, and doesn’t always antagonize, knowledge.

(2) To examine the reproduction of non-knowledge, and the “frames” used to decide what should remain unknown within a culture.
To assess the relationship between ignorance and power, or the Foucauldian "regimes of ignorance."

This dissertation engages directly with the first two objectives, arguing (1) that ignorance can be productively instrumentalized to sort through information based on its utility and applicability to particular case situations and (2) that medical students develop sufficient knowledge frameworks based on numerous factors unique to the social environment of their medical learning and eventual practice. Though this dissertation does not expressly underscore the theme of power, it does consider the manner in which those who enter into a position of expert power learn to manage and utilize ignorance in ways that enable them to be more effective physicians.

In line with these objectives of study, other anthropologists have also studied ignorance and non-knowledge specifically within medical systems. Outside of the literature on medical uncertainty, studies that directly address ignorance and non-knowledge in biomedicine include work on non-knowledge in incomplete medical records (Street 2011), and failures to "know" structural factors in public health initiatives for obesity (Sanabria 2016). Other anthropologists (Littlewood 2007; Last 1981) have argued that the notion of a medical system as a complete body of knowledge becomes untenable whenever patients and practitioners only know parts of that system, and ignore or overlook other dimensions of the medical system. Geissler found that in public health projects in Africa, material inequities between social groups were not always represented in epidemiological data and medical interventions, creating
“unknowing” about these dimensions of health (Geissler 2013). Related studies in the history of health (Proctor 1996; Pinto 2017) have considered the production of ignorance by the tobacco industry to create doubt around the cancerous effects of smoking. In sum, while the anthropology of medicine is dominated by studies of the social construction of knowledge or uncertainty, there is a growing body of work—of which this dissertation is a part—that seeks to examine ignorance and not-knowing in other regards within medical practice and learning. In the tradition of these accounts of ignorance within ethnography and anthropology, this dissertation provides a new empirical analysis of ignorance to demonstrate how the particular local and social conditions around biomedical learning at Midwest School of Medicine generate new relationships between knowing and not knowing.

SUMMARY

In this dissertation, I will weave together three distinct yet interrelated bodies of academic literature: the social science of biomedical education and practice, science and technology studies/cultural studies of science, and agnotology or ignorance studies. Within each field, I will contribute new ethnographic data and analysis that expands key conversations in these scholarly fields. In the sociology and anthropology of medical education and practice, this project seeks to expand ethnographic understandings of non-knowledge beyond uncertainty. The ethnographic chapters here will provide new data and analysis that underline the centrality of ignorance in medical students’ conceptions of knowledge and their relationship to knowledge as future
physicians. Regarding science and technology studies, I will utilize the framework of the social construction of scientific knowledge to analyze how the conditions of training at an American medical school co-produce knowledge and ignorance. In the tradition of both anthropology and science and technology studies, this project supplies an empirical account of the development of ignorance and knowledge within the day-to-day experiences of medical students and their mentors. Finally, I engage with the interdisciplinary field of agnotology or ignorance studies to provide a new typology of ignorance, sufficient knowledge, which bridges the theoretical space between epistemology and agnotology and which further maps the relationships between knowing and not knowing within an ethnographic framework.

In its totality, I posit the meta-argument that the anthropology and sociology of biomedical practice and education as well as science and technology studies have overlooked ignorance and the role that not knowing plays in daily scientific life and practice, despite the rising theoretical prominence of agnotology as a model for understanding the ways in which not knowing is socially mediated. As data in upcoming chapters will illustrate, when medical students learn, they make conscious decisions about what must be known and what can be forgotten or set aside given the conditions of their learning. As I will argue in the chapter on factors of sufficient knowledge, these choices are mirrored in the way that medical practice itself is arranged, as based on the accounts of advanced medical students and physician faculty members. Moving beyond uncertainty, I will demonstrate how medical students’ experiences of a
new form of ignorance—sufficient knowledge—are positive, productive, and meaningful, and how non-knowledge is consciously and actively produced by physicians-in-training.
CHAPTER 2: Methods and Field Site

INTRODUCTION

In this chapter, I will describe the methods and research design of this study as well as the characteristics of my field site, study population, and the venue where I completed observations. This chapter will begin with a description of the field site, Midwest School of Medicine (MWSOM), including the organization and activities within the mock clinical course (MCC) where I observed, and the personal characteristics required of students to learn within this curriculum. I will also note how the MWSOM curriculum is divided between basic sciences and clinical training. Next, I will outline the process of gaining access to the field site, and consider how my entry into the field aligns with the experiences of anthropologists who “study up” (Nader 1969; Gusterson 1997; Ortner 2010), as well as how my own social status within my field site impacted access and initial fieldwork. In the subsequent section, I will overview the demographics of my primary study population (medical students at MWSOM), as well as the sampling plan and consent protocols used for this project.

The latter sections of this chapter will outline the methodological approaches used in this research. This study drew upon a two-part methodology consisting of observations and interviews, influenced by existing ethnographic and qualitative research designs in medical education (Atkinson and Pugsley 2005; Charmaz and Olesen 1997; Cleland and Durning 2015). The first methods section will explain the nature of the observations I completed, while the second methods section will recount the semi-structured interview designs that I
implemented for medical student and faculty participants. This overview will be followed by a description of the analytical approach and techniques applied to the data, as well as a section noting the limitations surrounding this project’s design. The chapter will end with a summary of the methodology and its importance in developing meaningful ethnographic data on medical learning.

DESCRIPTION OF THE FIELD SITE AND OBSERVATIONAL VENUE

The data presented in this dissertation were drawn from 14 months of ethnographic fieldwork from March 2017 to May 2018 at a medical school in the American Midwest that I have given the pseudonym “Midwest School of Medicine” or MWSOM. In the next few paragraphs, I will describe the medical school field site and specifically the course where I completed observations. I refer to this course as the “mock clinical course” (MCC.) Though this class was designed to be the intellectual center of the MWSOM curriculum, students do complete coursework and training in other venues that I will not describe here in depth. These include courses and laboratory sessions in histology, pathology, and anatomy, as well as classes on ethics, professionalism, and physical examination and diagnosis skills. Students also have lectures three times a week, where attendance is optional. The content of the lectures and the MCC content generally overlap, and lectures often enable students to learn in preparation for their studies in the MCC.

MWSOM is a prestigious allopathic medical school located within a metropolitan center in the Midwestern United States. The school has affiliations with four regional hospital systems that serve a wide range of patient populations
spanning urban and rural, marginalized and wealthy, veteran and civilian, and people of a multitude of ethnic and religious backgrounds. MWSOM attracts incoming medical students from across the country and from neighboring Canada, in addition to a smaller contingent of international medical students from overseas. Each entering class consists of approximately 220 students, out of about 7,000 applications, for an enrollment total of about 880 medical students across the four years of training. Some of these students are enrolled in dual-degree programs across the university where the medical school is located, including Ph.D. programs in the biosciences. The curriculum in the first two academic years of medical school at MWSOM covers the basic sciences on human disease and health. The material is divided across six thematic “units” (rather than semesters) that last between one to four months, with cumulative exams at the end of each unit and weekly homework assignments in between.

In addition to interviewing both medical students and faculty members at MSWOM, as I will outline in the forthcoming sections, I completed weekly observations in the mock clinical course (MCC), alternating between a first year group and a second year group. Multiple faculty members described the MCC to me as the “crown jewel” of the MWSOM curriculum, and it became an experimental space where students were given the opportunity to make decisions around learning and knowing that in part resulted in sufficient knowledge practices. In the MCC, eight to ten medical students and one faculty facilitator meet as a small group two to three times per week to discuss one or two mock clinical cases; I will describe the contents of the worksheets and the
students’ process of analyzing them shortly. The groups meet in small, conference-room sized classrooms that are equipped with a projector, a projector screen, white dry erase boards, dry erase markers, and sometimes other tools such as anatomical models. Students are free to bring breakfast foods, snacks, and coffee to the meetings, which are held between 8am – 10am and 10am – 12pm.

As a group, the students read through and discuss the weekly “cases,” which consist of typed packets of information that contain a narrative about a patient’s illness history, social history, and treatment plan as prescribed by a physician. Relevant x-ray images, laboratory value tables, and other diagnostic test results are also printed within the packet. At the top of the page, an overarching goal is written that is intended to guide students towards the main themes that arise from the case. For example, a case worksheet might detail the story of a woman who comes to the clinic complaining of a racing heartbeat, sleeplessness, and chronic worrying that is identified as psychiatric in nature. The goal would read: “students will learn and differentiate anxiety disorders."

From these narratives, students are expected to identify and then learn the relevant pathophysiology, normative biology, and therapeutic mechanisms that the case introduces. The students would read the case together, create their own learning objectives for these cases, and then use those objectives to frame their studying and discussion each week. These were called the “unofficial learning objectives” or ULOs. At the end of the week, students received the “official learning objectives” or OLOs, which were the objectives that the faculty
had developed for that week’s cases. Students could use the OLOs to see what aspects of the cases that they missed, if any. A facilitator—either a faculty person, physician volunteer, university bioscience or clinical researcher, or fourth year medical student—was present to guide discussion as needed, though they were explicitly trained not to verbally intervene unless the students were incorrect and did not self-correct one another. Though students did turn to facilitators and faculty members to model their answers and gain of sense of how much information and what types of knowledge mattered most in each case, they were also able to self-direct their studies and make independent choices about what they believed to be significant in the case worksheets.

Within this training environment, it is crucial to note that medical students at MWSOM were effectively required to have a high level of interpersonal and communication skill in order to function in learning teams, and these qualities may not be characteristic of medical students at every institution. The medical students at MWSOM noted that amongst their friends and peers at other medical schools in the United States, MWSOM had a reputation for attracting future physicians with the best “soft skills” or “people skills.” Their sentiment was corroborated in a Fall 2017 meeting on campus for pre-health advisers, during which one of the medical school deans impressed upon the audience the value of attracting medical students with verbal and communicative skills beyond their scientific abilities.

While the medical students joked amongst themselves that their institution was fixated on “soft skills,” it became clear through observations that these
characteristics were, again, essential given the format of the curriculum. Quite pragmatically, students within a heavily peer-led curriculum need to be introspective, self-aware, and able to comment thoughtfully on the actions of other team members; at the beginning and end of every MCC session, students are required to comment on their participation and the participation of others in the group, and they are assigned written reflections of their contributions to the group throughout each unit. Therefore, the curriculum at MWSOM may have selected for a student population that was more likely to think about their knowledge development and the limits of their own knowledge than student populations at medical schools with different curricular models.

In addition to the personal characteristics of the student population, it is also important to clarify the way in which the curriculum itself is divided between pre-clinical and clinical years of training. Traditionally, medical school in North American has been divided into two parts across a term of four years since the early 20th century (Rothstein 1987; Bonner 1995; Ludmerer 1999; Cooke et al. 2006). The first part is a two-year survey of the basic sciences related to human health, while the second part is a two-year clinical apprenticeship referred to as “clerkship” or “rotations.” The period of medical school where I focused these
classroom observations is referred to as the “pre-clinical” years (A. Kaufman 1985), which is not necessarily accurate given that first and second year medical students at my field site also shadowed physicians, volunteered at a local free clinic for marginalized patients, and completed a week of clinical skills training each block as well as practiced physical examination skills on standardized patient actors at a simulated clinical space on campus: all forms of clinical experience. Though I did not directly observe these venues during dissertation research, I did observe at the simulation space in pilot research, and I was familiar with the clinical learning opportunities that were designated for first and second year medical students.

“Clinical” students in the third and fourth year of training spend most of their time on the wards, observing patients and performing some tasks such as minor procedures or patient history taking. At MWSOM, medical students in the
clinical years are not confined to the clinic, and they too attend lectures and participate in required group discussions held in classroom environments. Thus here I use the term “pre-clinical” to refer to the first two years of medical school that are dominated by classroom learning, and the phrase “clinical” to refer to the third and fourth year where training occurs most commonly in the hospital and outpatient facilities, with the understanding that medical education is not so neatly bifurcated.

ACCESS, STATUS, AND “STUDYING UP”

Like other anthropologists who have “studied up” into powerful and selective social and professional communities (Nader 1969; Gusterson 1997; Ortner 2010) I experienced some challenges in accessing and later working with my study population, which consisted of extensively educated students on the path to becoming elite members of the medical profession. I came to navigate a complex educational bureaucracy before I was granted permission to research from the “gatekeepers” (Wanat 2008; Reeves 2010; Bondy 2013) at my field site. Understandably, physician faculty members with obligations to both teach and to engage in clinical practice had little time to review research plans. Basic science faculty often had their own graduate students to mentor and laboratories to manage. Instead, I negotiated access through the director of medical education research at my field site. The director presented my research design to the faculty committee and then relayed their expectations around my research plans back to me, as well as giving me additional feedback and recommendations based on her work as an educational psychologist.
My original research plans went through a series of changes as I amended my design based on the expectations of the faculty as transmitted to me through the director. Each iteration of my edited research plans were then reviewed by the faculty members of my dissertation committee, and approved as amendments to my original protocol as certified by the Case Western Reserve University Social, Behavioral, and Education Institutional Review Board (IRB.) Though I had originally intended to complete observations in four venues in the curriculum—the anatomical laboratory, the simulation center for physical diagnosis training, the mock clinical course (MCC), and a weekly seminar on ethics and professionalism—I was only able to gain entry to the mock clinical course. These logistical hurdles made it difficult to enter the field, though they ultimately resulted in a more thorough plan for observations and in a greater understanding of the dynamics between faculty members and students, which I will describe in this section. The gatekeepers at my field site did not intervene in my plans to interview medical students, as these interviews were held outside of the medical school class schedule. Overall, the process of negotiating access to my field site took approximately 9 months between July 2016 and March 2017.

In this period of accessing and then initiating my research, my own social status was brought into question in ways that made it clear I was “studying up.” For one, it was not until my own academic advisers from my home department in anthropology scheduled meetings with key administrators at the medical school that I was permitted to begin my study, suggesting that I did not possess the social capital myself to enter the field. Further, faculty members, administrators,
and medical students often treated me with skepticism until I mentioned that my father and father-in-law are physicians, at which point many made references to my “understanding” of the social lives of physicians. These exchanges cued my relative insider’s knowledge: though since I was not a clinician myself, I was still at a critical distance from firsthand encounters with patients.

My status as a researcher was also brought into question by the medical students, who sometimes made wry references about Ph.D. faculty and students being “out of touch” with the realities of clinical practice. Though the medical students I worked with repeatedly assured me that I was “one of the Ph.D.s that we like,” and affectionately called our interview meetings “therapy where you pay me in gift cards,” it was clear that my training and position as an anthropologist were of a lower status than those of a physician. In many ways, this lower status position was beneficial, as the medical students identified with me as a fellow graduate student who could commiserate over exams, assignments, and staying abreast of important scientific literature. They were not concerned that I would judge them if they confessed to not knowing something, especially since the precise content of each conversation was kept confidential from faculty and administrators. Students were more frank in their interviews with me than in their discussions with faculty in observations, particularly when admitting the types of information that they believed to be less important or chose to ignore. Their accounts allowed me to understand sufficient knowledge practices in a way that I might not have if I were a faculty person or administrator.
In contract to other anthropologists who have “studied up,” though, my participants were both future members of an elite profession as well as students who were positioned at the bottom of their career hierarchy. Their ability to participate in my research was mediated by the curriculum leaders, who had particular expectations about the way I needed to gather consent from the participants, how long I would be allowed to remain at the field site, and how I was expected to observe within the classroom environment: that is, with very limited participation. The curriculum leaders invited me to observe in the mock clinical course (MCC), but I was discouraged from observing and later denied access to observations in other medical student courses such as a seminar on ethics, professionalism, and health disparities, as well as larger team-based discussions, interprofessional workshops with students in neighboring clinical programs such as dentistry and nursing, and laboratory sessions. The students themselves did not decide whether or not I would be able to observe with them in these spaces.

While this level of guidance from the curriculum leaders ultimately bolstered my research design and helped me to establish clear protocols around consent and research practices, it did limit me from having full access to observations across the curriculum and to students’ experiences in a broader sense. Further, the complex status relationships between students, faculty, and myself as a researcher at the medical school came with their own consequences, both helping and hindering the fieldwork I would undertake as an ethnographer. My own positionality as a PhD candidate, a graduate student, and the family
member of physicians at once bolstered and curtailed my social purchase within MWSOM. Thus, while the process of gaining access to my field site was instructive in outlining my own role as a researcher in the context of my field site and study population, access difficulties inherently altered the nature of the methods and consequent data presented in this dissertation.

**DEMOGRAPHICS, SAMPLING, AND CONSENT PROTOCOLS**

In this section, I will begin by describing the demographics of the medical student interview cohort, observational population, as well as the overall student body at MWSOM, and then detail the sampling plan used for interviews and for observations. Throughout this section, I will also explain the consent protocols for the two-step research process consisting of consent for semi-structured interviews and a separate, anonymous consent process for classroom observations. Drawing on purposive, convenience, and snowball sampling methods, this study sought to gather a representative sample of medical students and faculty members: especially a student sample that reflected the same ethnic diversity and gender parity of the medical student population at MWSOM.

I completed 71 semi-structured interviews (Galletta and Cross 2013) with medical students. 41 students completed the first interview, with 30 students from the first interview cohort completing the additional second follow-up interview. Interviews typically lasted between 30 and 60 minutes, with the shortest interview being 29 minutes and the longest being 1 hour and 30 minutes. Student participants received a $25 Target gift card for each interview, for a total of $50 if they completed both the first interview and the second follow-up interview.
Faculty participants did not receive compensation for interviews. I met with faculty in their offices for our interviews, and I met medical students either in a private office space for graduate students or at cafes and coffee shops around the medical school. Half of the medical students expressed interest in meeting at a cafe or coffee house, and I completed approximately one third of student interviews in these public spaces, which were frequented by both fellow students and by faculty members. This indicated that medical students were unconcerned with the confidentiality of their responses, and that they had little hesitation sharing their experiences of uncertainty and not knowing in an open venue. My medical student participants similarly explained that they felt comfortable voicing critiques of the curriculum to the faculty members, and that they frequently shared their lack of knowledge or uncertainty with other students, in both the group discussion setting of the MCC and outside of class in social situations.

Interviewees included 14 first year medical students (M1s), 19 second year medical students (M2s), and 8 fourth year medical students (M4s.) There were 13 men and 28 women participants, though the medical school student body itself is approximately 50% men and 50% women. Students’ ethnic identities amongst both the interview cohort for this study (M1, M2, and M4) and for the entering M.D. Class of 2021 for comparison overall (a drawn from medical school public records) were as follows:
The students who completed semi-structured interviews were initially recruited as a stratified convenience sample (Agar 1996; Bernard 2006; Bernard and Gravlee 2014) on a first-come, first-serve basis as they learned about the study from flyers, email announcements, and word-of-mouth at the field site. Initially I sought to fill 15 interview spots with M1s, 15 spots with M2s, and 15 spots with M4s, however there were fewer M4 participants and a greater number of M2 participants in the final sample. I turned to a convenience sampling method after a more structured, random sampling of participants within the classroom observations failed to attract a great enough number of participants. For the M1 and M2 cohorts, the first participants to approach me were almost exclusively women. As I approached between 7 and 10 students in the M1 and M2 stratified samples, I began to specifically ask women students to invite their male colleagues to participate in order to achieve a more equitable gender balance. This snowball sampling technique was somewhat effective and did boost the number of men enrolled in the semi-structured interviews, though more women than men ultimately participated. The women students readily invited their male
friends, however a number of the women confessed to me that the compensation for interviews (a $25 gift card to Target) was of more interest to them than to the men in their class.

The study also sought to meaningfully include medical students in the later years of training. Third-year medical students (M3s) were omitted from the study due to the time constraints in their schedule during third year clerkship, which would have made participation from this group very difficult. Fourth-year students were recruited instead and asked to reflect on their third-year experiences to make up for this gap in the ethnographic data, though fourth year students were also difficult to recruit given that they were often traveling for residency interviews, away rotations at hospitals in other states, or were occupied in acting internships (wherein fourth year medical students are given responsibilities similar to a first-year medical resident or “intern.”) For interviews, all students were asked to sign an informed consent document at the first interview appointment that they were given a copy of to read and review in advance of the scheduled interview. Students had the option to be audio recorded or to be not audio recorded, or to pause the audio recording at any time during the interview. All of the students in the study consented to audio recording.

In observations, the group membership was divided with half women students and half men students, with anywhere from 8 to 10 members per group including a faculty or fourth year medical student facilitator who could assist and guide the group when needed. The gender division was an intentional choice on the part of the curriculum leaders who assigned students to their groups for each
unit to ensure gender parity in the group discussion. The groups were multi-
ethnic and educationally diverse, with students who held a variety of
undergraduate degrees in the sciences and humanities, and some who held
additional graduate degrees including masters’ degrees, and one participant who
had previously completed a PhD.

The consent process for observations was more intricate than for semi-
structured interviews. In order to observe, the key stakeholders at my field site—
the curriculum leadership consisting of medical school faculty and deans—asked
that I only observe in groups where all members agreed to participate, and where
this participation was documented yet anonymous. Therefore, I created the
following system for observational consent: I would distribute a packet to each of
the groups at the beginning of each unit. The envelopes were marked by
someone in the class with the number of their group, which would safely make
the envelopes distinguishable from one another as only the curriculum
administration had the master list of what students were assigned to each
numbered group. Everyone in the class, including the students and the facilitator,
would read a description of the study and then complete a consent document by
checking a box on a form that said either “I agree to participate” or “I do not
agree to participate.” One person in the class would then write down how many
people (students plus facilitator) were in the group.

After 48 hours or two classroom meetings, I would collect the packets and
then tally the number of “I agree” responses, marking which groups had offered
100% consent: i.e. the number of “agree” forms matched the number of people in
the group. I would then record the group identifier numbers for these groups, and ask the curriculum administrators to send me the contact information of the facilitator for each group. I would then randomly select one to two groups in each unit to observe where there was 100% consent (“agree” responses.) I would not observe in any group where 1 or more members had checked “I do not agree to participate,” or in any group where the packet documentation was incomplete or incorrectly completed. In general, there was a high rate of response and most of the class groups returned a consent packet. The responses were as follows below:

| Medical Student Group Observation Consent to Participate, by Packet Numbers |
|-------------------------------------------------|--------|--------|--------|--------|--------|--------|
| Total # of Groups (1 Packet each)               | UNIT 1 | UNIT 2 | UNIT 3 | UNIT 4 | UNIT 5 | UNIT 6 |
| # of Packets Returned                           | 22     | 22     | 22     | 22     | 22     | 22     |
| # of Groups with 100% Consent ("Agree")        | 14     | 14     | 20     | 19     | 16     | 22     |
| # of Groups without 100% Consent               | 6      | 6      | 7      | 8      | 6      | 2      |
| # of Groups with Incomplete Packets            | 5      | 5      | 4      | 5      | 6      | 8      |

Because the classroom observations were intended to be anonymous, there were no consent documents linking interview participants and classroom participants; students who wished to complete an interview would sign an informed consent document for interviews as well as complete an anonymous consent document agreeing to participate in observations. During observations, no names or identifying information on individual students was collected, though students who participated in both interviews and observations sometimes referenced activities in their classes during our interview meetings and outside of the classroom in less structured conversations.
In addition to the interview participants and group observation participants sampled for this study, I also completed 8 semi-structured interviews with deans and faculty members at the medical school (4 PhD basic scientists and 4 M.D. or D.O. physicians.) These faculty members were purposively sampled (Given 2008) based on their role in the curriculum, as one of the following: (1) a curriculum leader for the preclinical basic science years, (2) a dean in the school of medicine, and/or (3) a physician faculty member with clinical teaching experience. Like the medical student interview participants, faculty participants were given an informed consent document to review in advance of our interview meeting. They signed the consent form at the interview appointment and had the option to be recorded or not recorded. Only one faculty participant requested not to be audio recorded during our session.

To supplement these interviews, as it was often challenging to secure interview appointments with practicing physicians, I also spoke in a less formal capacity with four physician MCC facilitators as well as physicians who mentored students in various capacities across the curriculum. These conversations helped contextualize my data by representing perspectives on sufficient knowledge held by individuals who had completed training and who had experience in clinical practice. Likewise, as students sought out these individuals for shadowing opportunities and career mentoring, it was imperative to consider how their expectations and practices around knowing and not knowing would be transmitted and later modeled by the medical students in my cohort. On the other hand, I was careful not to impose physicians’ perspectives on students’ accounts
of sufficient knowledge, as the students developed their own ways of framing knowledge that I wished to examine independently in relation to training and early professional socialization.

METHODOLOGY AND DESIGN: OBSERVATIONS

The first part of this research design involved extended observations within the mock clinical course (MCC), which I described in detail in the previous sections. I completed 23 weeks of observations, with four to six hours of class time each week, for approximately 130 hours of observations. Observations were critical to understanding how medical students addressed gaps in their knowledge, utilized learning resources, and depended on one another to learn new concepts. The collaborative, problem-centered approach within the MCC proved to be an instructive site for examining how medical students make decisions about what information was important and relevant, what aspects of clinical cases to emphasize or de-emphasize, how to balance the time in sessions to appropriately cover all the material, and how to rely on team members with different academic strengths. During observations, I took both written notes as well as gathered visual data, including a series of images of my field site to demonstrate the layout and materials in the classroom space, as well as memes from online medical student forums on themes of knowing and not knowing that students commonly shared with me during the class breaks.

The field notes were organized in the same format throughout the course of the study. Each week, I typed notes into a single document that was divided into four sections: general description of the field site, Monday session,
Wednesday session, and Friday session. The general description section contained information about the classroom environment, activities occurring at the medical school outside of the MCC that week, the themes that students were covering in each unit, and students’ thoughts on upcoming exams or assessments. The three daily sections were devoted to notes specific to each class session that contained both descriptive and reflective content (Emerson, Fretz, and Shaw 2011). In these sections, I recorded descriptive information about the content of discussions, especially places where students remarked on what they felt they needed to know, what they did not know, and what information could be spared from discussion. I also recorded descriptive information about the content of the weekly cases and students’ verbal reflections in the “check in” and “check out” stages at the beginning and end of each session. These notes were punctuated with reflective questions and ideas about how specific interactions amongst the students might indicate broader relationships to knowledge and ignorance.

The observations were not wholly participatory (Agar 1996; LeCompte and Schensul 1999; O’Reilly 2012) given that it was important that I not intrude on the learning process that students underwent within the MCC. Students were encouraged to work through the material on their own with limited interjections from their facilitators, and I attempted to echo the facilitator’s role by not speaking during discussion. However, I did participate in other ways. I chatted with students during break times and at the beginning and end of each session, and this gave me an opportunity to ask clarifying questions if I was unsure of
something that happened in the classroom. Some MCC groups invited me to participate in “check in” and “check out,” whereby students go around the table and talk briefly about their thoughts on that day’s learning material and the performance of the group in the session. Despite the limitations around my role as a classroom observer, I was nevertheless able to gather meaningful data and connect with students in less structured ways around the design of the mock clinical course.

METHODOLOGY AND DESIGN: SEMI-STRUCTURED INTERVIEWS

As noted earlier, I completed a total of 79 interviews throughout the duration of the study: 71 interviews with medical students, and 8 interviews with faculty members and key stakeholders in the curriculum. The purpose of interviews was to develop a person-centered (Bernard and Gravlee 2014), experience-near (Agar 1996) description of the ways that students confronted and made sense of the boundaries around their growing medical knowledge. These personal accounts also allowed students to express how knowing and not knowing arose as themes in other venues of the curriculum where I did not directly observe. Semi-structured interviews were the ideal tool to characterize nuanced relationships between knowing and not knowing in medical training, and to identify new factors in the social construction of medical knowledge that would not have emerged on a survey or within a structured interview using pre-existing instruments.

Student interviews were completed in two rounds in order to detect any changes in students’ experiences and their overall knowledge across the
academic year, while faculty members were only interviewed once, primarily in the summer and fall of 2017 between rounds of student interviews. There were six distinct rounds of interviews scheduled at strategic points in the curriculum that aligned with students’ academic calendar and their growth across the academic year. The first round of interviews was held between May 2017 and July 2017 with rising second year students upon completion of their first year of medical school (M2 Interview 1.) The second round of interviews in July 2017 through September 2017 was organized for incoming first year medical students at the start of their first year in medical school (M1 Interview 1.) The third round of interviews (M2 Interview 2) was held between November 2017 and January 2018 with second year medical students, before their classes ended early in February 2018 so they could prepare for the USMLE Step 1 board exam in the spring of 2018 and clerkship in July 2018. The fourth round of interviews (M1 Interview 2) occurred between March 2018 and May 2018, at the end of the first academic year which concluded in May. Fourth year medical students could be interviewed at any point before their residency Match Day (May 2017 through March 2018, M4 Interview 1) and after Match Day (March 2018 to May 2018, M4 Interview 2.) This allowed me to consider how students’ residency match experience and later-stage clinical experiences in their area of future specialization impacted their understanding of knowledge and ignorance.

The interview guides were designed specifically for the purposes of this project, and were not based on any pre-existing interview or survey instrument. The guides were written to elicit students’ and faculty members’ experiences of
knowing and not knowing in ways that aligned with what I observed in pre-
dissertation pilot work that I completed with medical students at the same field
site, in the anatomical laboratory and at the simulation center where students
learned early physical examination skills. At first, the questions were centered on
the notion of uncertainty, as was this project. Later, as I gathered more data to
suggest that other forms of non-knowledge were present, I opted for a grounded
theory approach (Clarke 2005; Kennedy and Lingard 2006; Birks and Mills 2015)
in which I edited and added questions to the semi-structured interview guides
that more closely followed what my participants were describing. In this process,
the interview guides were living documents that dynamically captured students’
experiences as I learned more in the field. Interview guides for each individual
faculty person were also tailored to their position and to their professional
background as either a basic scientist or a physician as I learned more about the
stakeholders at my field site and the role of the curriculum leaders. However, to
ensure continuity in my data across the study, I chose to leave some questions
unchanged from my original interview guides. I also edited semi-structured
interview guides between rounds of interviews rather than between individual
participant meetings, so that the questions would be comparable for all of the
participants in each round of interviews and would not change suddenly between
participants. I welcomed feedback from student and faculty participants, who
suggested new questions and often explained how I could edit or reword existing
questions to make them clearer.
Student interview participants often asked for guidance on their responses, and while I hesitated to bias the data by outlining exactly the types of information or perspectives I hoped to obtain, I would explain to students when they asked that I was interested generally in the themes of knowing, not knowing, and knowing enough. If students initiated discussion that I had observed was important—for instance, the theme of teamwork or the impact of specialization on ignorance—I would ask further questions beyond those on the guide to confirm that this was a topic that I was curious about. This encouraged participants to subsequently expound upon that dimension of their experience in greater depth. Conversely, the medical students I worked with also made active attempts to direct my work and shape the scope of my research. They would tell me to write specifically about the USMLE Step 1 board exam, or to outline the terms that they used to describe sufficient knowledge. They also reminded me that their peers experienced a range of relationships to knowledge and ignorance and that not all medical student perspectives on ignorance are the same, though naturally common trajectories emerged in all of the responses as I will soon demonstrate. All of these student suggestions, amongst others, have been incorporated into this dissertation.

ANALYTICAL APPROACH

The data generated from this research was analyzed through both \textit{a priori} and \textit{emergent} coding schemes, as is standard for ethnographic research (R. S. Weiss 1995; Bernard and Gravlee 2014; LeCompte and Schensul 1999). The study drew on a set of \textit{a priori} codes developed at the outset of the study based
on themes identified in initial pilot work, and on the uncertainty construct as
described in earlier research. These codes were systematically applied to both
the written data from field notes and interview files in order to elucidate concepts
that were addressed in both sets of data. As the study progressed and more data
was gathered to suggest the new phenomenon of “sufficient knowledge,” I
developed a series of emergent codes to annotate these themes in weekly field
notes and interview notes. Emergent codes were centered on the topics of meta-
knowledge, sufficient knowledge, and various factors of sufficient knowledge as
they were uncovered through the research period. The codebook used for this
study, as well as the semi-structured interview instruments, are accessible in the
appendices of this dissertation.

The transformation of coded data into ethnographic findings was both
deductive and inductive: deductive, in that I focused observations and interviews
on the themes of knowing and not knowing from the outset, and inductive, in that
I adapted the framework I used from “uncertainty” to “sufficient knowledge” as
this new theme arose from ongoing data collection. As an epistemologist, I
carefully differentiated levels of knowledge through my coding schemes
throughout the course of the study, from base level knowledge of the course
content, to meta-knowledge about the expectations of faculty and expectations
around exams, and meta-knowledge around knowing how to select for the “right”
forms of information based on a number of factors. I used NVivo 11 software for
coding data and for tabulating the number of data points under each thematic
node.
In addition to written data in the form of ethnographic field notes, I also analyzed other complementary bodies of descriptive data, both visual and numeric. I gathered and tabulated numeric data on the number of students of each ethnicity and number of consent packets returned (see above) and drew on existing demographic data on the medical student population provided by MWSOM. I also referenced faculty-designed case worksheets utilized in the mock clinical course (MCC) to contextualize the observational data I had gathered in the MCC. Overall, it was critical to combine coursework observations, interviews, and the aforementioned supplemental forms of data to gain both a sense of community dynamics around the construction of sufficient knowledge, as well as individual narratives around how students made decisions about knowing: particularly in order to account for variations in the ways that medical students actively engaged with and limited their knowledge, and differences in students’ levels of acceptance or anxiety about bounding knowledge at numerous points in the curriculum. This study’s dynamic analytical scheme was able to shift in response to the data collected, while retaining the a priori focus on knowledge that gave the project a strong and reliable trajectory.

LIMITATIONS

The design of this project imposed some logistical constraints that inevitably shaped the data I gathered, though I made conscious choices about the methodology to account for these limitations where possible. While the mock clinical course (MCC) was certainly at the heart of the students’ learning at MWSOM, students’ experiences of knowing and not knowing in other courses
and venues in the curriculum may also have been helpful to witness first hand. Likewise, it was not possible to follow third and fourth year medical students in clinical clerkships because (1) students rotated through four distinct regional hospital systems as well as at hospitals out of state and across the country, making it untenable to gain access to students across many sites with their own IRBs and research requirements, and (2) these clerkships overlapped with existing observations in the pre-clinical basic science courses, where I hoped to focus most closely on the initial development of sufficient knowledge practices especially within the framework of a student-led curriculum.

These missing data points were in part accounted for by semi-structured interviews, where medical students often talked about training experiences that I did not observe firsthand. Interviews with fourth year medical students, physician faculty members, and pre-clinical medical students with shadowing and past clinical work allowed me to capture the experiences of knowing and not knowing from the clinical angle, despite not observing directly within the hospital space. Similarly, by focusing on the pre-clinical years most closely, I was able to generate a picture of early professional socialization at a time when students are faced with the most gaps in their knowledge. In this way, the period of training where I observed and gathered much of this data served as a kind of natural experiment, wherein I was able to watch the sufficient knowledge process “becoming” (Biehl and Locke 2017) and match what I learned about the nature of clinical practice through advanced medical students, their physician mentors, and existing accounts of uncertainty and non-knowledge written by physicians.
SUMMARY

This dissertation is an ethnographic investigation into the social construction of sufficient knowledge at an American medical school. In order to evaluate the ways in which medical students “make” knowledge and prioritize information, it was critical to observe them both in the classroom space where they were challenged to write their own objectives around clinical case narratives, and to interview students to gain a more personal and experience-near account of how they navigated the large amount of information they faced in medical training. Interviews with faculty members also illustrated their expectations around sufficient knowledge for students, and interviews with both students and faculty gave participants an opportunity to voice differences in the way they resolved questions around knowing enough, and in what contexts.

The study faced some limitations due to the negotiation of field site access with key stakeholders at the medical school, and the unavailability of physician and advanced medical student participants. However, these limitations ultimately informed me of the social position of medical students, faculty, and researchers within the institution, while less structured interactions with medical school faculty members allowed me to learn about the relationship between sufficient knowledge and the realities of clinical practice. The study’s design was bolstered by an experience-near methodology that was able to illustrate students’ direct attempts at managing knowledge, sharing information with peers, and developing objectives around the material they were given. In all, the methodology of this project was tied closely to the nature of the curriculum design at the field site,
and to the ways that medical students at Midwest School of Medicine (MWSOM) learn and develop as future physicians.
CHAPTER 3: Constructing Sufficient Knowledge

INTRODUCTION

“The social construction of sufficient knowledge” reads like lofty theoretical jargon, yet no other phrase so elegantly or simply captures what I found during my ethnographic research. My anthropological findings indicate that medical students build (construct) their knowledge based on what they understand to be enough (sufficient) for the purposes of their exams, their classroom work, and their clinical training. In this chapter, I will describe how these venues situate medical students towards knowledge and ignorance: in other words, how the social environments of classrooms and clinics lead medical students to make choices about knowledge based on perceived utility, applicability, or value. I will likewise argue that the design of the curriculum—which encourages student-led learning—encourages students to be sparing and pointed about the content and scope of their studies. These sections will be followed by a close reading of the three local terms that MWSOM medical students use to characterize sufficient knowledge: high yield, low yield, and rabbit holes. The final section will explore how fourth year medical students are socialized to make conscious choices about knowing and not knowing during clinical training on the hospital wards.

To these ends, I will analyze data from interviews and observations that I conducted over fourteen months at Midwest School of Medicine (MWSOM.) The data presented here will span interview quotes, observational notes, and images from my field site. I will argue that, comparable to Latour’s description of the “black box” (1988), scientists and scientific professionals intentionally draw
boundaries around what must be known for day-to-day practice, and what can be
ignored. As the data makes clear, medical students are not unconsciously
ignorant. I will demonstrate in this chapter that medical students instead
construct their knowledge (and ignorance) meaningfully within the scope of
training across all four years undergraduate training.

SUFFICIENT KNOWLEDGE AND CURRICULAR DESIGN: NORTH AMERICAN
MEDICAL EDUCATION

There have been substantive changes in the structure of medical
education in the United States and Canada since the 1970s. Namely, new
curricular models have emphasized student-led and student-centered learning.
These forms of curricula deemphasize the role of faculty teachers, and instead
reposition medical trainees to make at least some of their own choices about the
scope, depth, and breadth of their knowledge. These changes warrant further
ethnographic discussion about how medical students today are socialized
towards sufficient knowing, both internationally and in the context of my field site.

The most radical historical change in medical education, and the model
adapted in large part at my field site, is problem-based learning (PBL.) PBL is a
curricular model that was initially designed for the medical school at McMaster
University in Canada in the 1970s and 1980s (Barrows 1996, Neville 2008). PBL
is a form of “active” learning in that students do not passively receive information
from expert instructors, but rather, develop and frame knowledge on their own.
The PBL model aims to mimic the problem-solving process that physicians
engage in as they examine, diagnose, and treat patients with a range of illnesses
and medical concerns (Barrows and Tamblyn 1980).
In other words, the students—like physicians—are confronted with a detailed body of information that they decipher with their colleagues, here fellow students. Students must simultaneously acquire knowledge through the study and discussion of cases, as well as meta-analyze the goals, framework, and scope of the knowledge they are gathering individually and as a group. The group is assigned a facilitator, who at MWSOM can be a faculty person, a physician, or an advanced fourth-year medical student. The facilitator ensures that students’ discussion does not veer too far away from the material that is deemed most vital by the faculty curriculum leaders, while intervening as little as possible in the discussion such that the students have space to independently resolve their own questions and address the topics that they wish to prioritize. The facilitator can also offer students narratives of their clinical case experiences or research for additional context.

The PBL model proliferated in medical schools around the world through the early 2000s (Neville 2008). By 2004, 70% of medical schools in the United States had instituted some form of PBL (Kinkade 2005). The growth of problem-based learning and similar instructional formats continues today. Out of 127 U.S. medical schools surveyed in 2013, 116 schools planned to implement “enhanced use of active/engaged learning formats” in their curricula in the subsequent five years (AAMC 2013). In 2016, 58% of medical schools surveyed by the Association of American Medical Colleges (AAMC) were using some form of PBL in their curricula (Whyte 2016), though the majority of medical schools had
implemented some form of small-group or team-centered discussion in their coursework.

This shift may seem primarily important to education scholars, but it is equally important for ethnographers of medical education and practice who study the socialization of physicians in North America. In this model, students are not made to confront and then ‘cope’ with an endless body of medical-scientific knowledge, as Fox (1957) and Becker et al (1961) observed in the past. As I have found, medical students who are taught in a PBL environment are oriented towards medical knowledge in a fundamentally different way. They are expected to work through the material on their own, with little interjection by a faculty or advanced medical student facilitator, and to decide what aspects of the case they will examine in the time allotted for their session. My observations at MWSOM are echoed in the literature. “The ultimate responsibility for establishing the learning objectives and determining the resources for learning are placed with the learner,” Whyte summarizes (1996).

Therefore, medical students trained in these self-directed learning environments are situated to both learn independently and to make meta-level choices about the frame, scope, and purpose of the knowledge they seek to acquire. I further posit that students in this environment do not seek complete knowledge, but directed knowledge: “enough” of an understanding of a case that it satisfies the goals they have generated. Students are also tasked with sharing that knowledge between fellow learners such that knowledge is not individual, but collectively shared and transmitted. Knowledge is not only individually “enough,”
but deemed sufficient by the group; likewise, students do not cope with not knowing, but often choose not to know when that knowledge lies outside of the objectives that they have designated for their studies. As one participant in my study (Charlie, second year medical student) reflected in an interview:

“The self directed nature of the curriculum affords for a greater amount of uncertainty. Because no matter how much effort you put into strategizing around any given [topic], you always, you're left feeling that there are things that are missing. Part of that is that people have different strategies. I imagine if you have a sheet of paper, and you have everything you need to learn on that paper, you have to draw a line around [what you really need], and that line is not going to be square, and not the same for everyone. What do you emphasize and de-emphasize? And underlying that is the way you [individually] approach learning that information. That's how we benefit from each other too, so it's a pro as well.”

Social scientists of medical education have much to gain by turning the ethnographic lens onto problem-based learning environments in medical education. As new generations of physicians are increasingly trained under this curricular model, it becomes especially important to consider how medical knowledge may in turn be framed in new ways. As the curriculum seeks to position medical students towards knowledge by making them actively choose both what knowledge and how much knowledge to acquire, we must consider how these positions alter what becomes medical knowledge and ignorance, and to what degree. As I discovered through my own ethnographic work, medical students do not merely cope with or tolerate uncertainty, but instead actively implement ignorance as a useful, purposeful mechanism for limiting medical knowledge. Strategically ignoring information also allows future physicians to sort through an endless amount of medical knowledge and make decisions about the scope, depth, and relevance of information rather than becoming immobilized by
the need to know it all. I will return to these themes throughout the ethnographic chapters of this dissertation.

SUFFICIENT KNOWLEDGE IN THE PRECLINICAL YEARS: THE MOCK CLINICAL COURSE

As stated in the introduction of this dissertation, “sufficient” is defined as “of a quantity, extent, or scope adequate to a certain purpose or object” (“Sufficient (Adjective)” 2018). We must not only consider what forms and amount of knowledge are “enough,” but also what context this knowledge is sufficient within. Though the types of information that medical students choose to know are often the same across venues, from the classroom to exams and the wards as clinical students, I found that the educational venue can and did have specific effects on medical students’ epistemological choices. In this section, I will highlight how the PBL classroom of the mock clinical course (MCC) becomes an environment that fosters thoughtful and strategic limitations around knowledge within preclinical training. In this section, I will review ethnographic data from my research that illustrates the socialization of medical students within the MCC towards sufficient knowledge, and the changes that students experience as they develop sufficient knowledge practices from first year to second year. This section will be complemented by the subsequent section, which will explore how the context of exams (from unit examinations to board exams) leads students to generate epistemological and agnotological boundaries.
I would like to begin by describing the educational environment of the MCC, and the ways in which the curriculum within this venue socialized medical students towards sufficient knowledge. The descriptions here are drawn from my own ethnographic field notes as well as from interviews with students about the design of the curriculum. The mock clinical course (MCC) begins in July for first year medical students. As outlined in Chapter 2: Methods and Field Site, each MCC group contains between eight to ten students split evenly between men and women, with one facilitator present to guide the team as necessary in the style of problem-based learning. The students are assigned one to two case worksheets each week. They are asked to formulate “unofficial” learning objectives (ULOs) based on the content that they each understand to varying degrees within these case worksheets. These worksheets described the complaints of a patient as well as their medical condition(s), its progression, and the patient’s social history.
as well as any treatments they received; the students’ unofficial objectives would be to study the content in each part of the patient’s case, from pathology to laboratory values, diagnostic tests and relevant pharmacology. First-year case worksheets were relatively straightforward, whereas in the second year of training, the case worksheets became more complex, tasking students with developing a differential diagnosis for the patient in the worksheet based on the knowledge they had gained over the first year of medical school.

Each week, a student in the group served as “leader” and helped to guide objective formulation and discussion. At the end of each week, students could access the “official” objectives (OLOs) online, which consisted of a list of questions and concepts that the faculty leaders who design each unit hoped that students would cover in their weekly MCC studies and discussions (and that formed the content on exams.) These official objectives became the comparative measure by which students could tell if they had studied enough. They did so by gauging whether their own objectives matched the official objectives, such that they had prioritized the “right things,” in their words. First year students were especially concerned with matching their ULOs to the OLOs, and did whatever they could to reveal the official objectives earlier in the week so that they would know precisely what topics to prioritize in their discussion and studying. Consider the following cases:

M1s will find out the official LOs in advance, be it through medical students with older siblings also enrolled at the same medical school (who tell them about past objectives) or through facilitators who will give students OLOs so that they don’t go astray in their ULOs. This is not a practice condoned by the medical school, since this defeats some of the purpose of problem-based learning, where objective formulation is initiated
by the students (Interview notes from a conversation with Lia, a second year medical student.)

The students debated why norepinephrine was given to the mock patient in this case. One student said that this would be something they “needed to research.” Another student said that “this was on the OLOs, but it wasn’t really clear,” suggesting that this student might have figured out what the official learning objective indicated about this topic or had access to this week’s OLOs from other students or the older version of their online curriculum website: which, at the time of writing, was not disabled and which contains MCC resources that students can still access (Observation notes, week of 5/8/2017.)

In the early units (1 through 3), first year medical students hotly debated what their unofficial objectives should be. I recorded exchanges between students as they toiled over the exact language used in each objective, and fretted about how the objectives should be ideally organized. They often formulated a greater number of objectives than what were contained in the list of official objectives. The medical students realized—with time—that their own expectations for the scope and depth of their knowledge were more stringent than those of the faculty members: whose expectations, I found, typically mattered more to first year students than to second year students. These sentiments were carried by students throughout our interviews.

Amy, a first year medical student, confessed to me that “they [the ULOs and OLOs] haven’t not matched, because we have too many, there are superfluous ones.” Rashida, a first year medical student, admitted when I first met her that, “we can have 15 ULOs in a week where there’s only 8 OLOs. But we are better than other groups. We have gotten better about consolidating our LOs, but there have been times when we’ve missed an official LO.” Other first year groups early in the academic year also became frustrated when their
extensive list of ten to twenty goals contained more information than the seven to ten official objectives typically designated for each case.

By the end of first year and the beginning of second year, it was clear in both our interviews and in my observations that the medical students became less dependent on the official objectives. They expressed confidence in the scope and content of the unofficial objectives that they formulated in their small group discussions in the MCC. “The consensus in Unit 4 is that you have to know what is in the lecture and the textbook,” Rashida, a medical student at the end of her first year said, “and the OLOs match what’s in the book so it’s easier to know how much detail to go into. I don’t really look at the OLOs though, because I use the ULOs. Because I feel like I’ve already done the LOs and I don’t need to do them again.” Other students commented that while they referred to the OLOs in their weekly studying, they often copied and pasted what they had typed in their notes for the ULOs that week into a new document with the OLOs listed. This process rendered the OLOs a way to thoughtfully reorganize notes, but not to change the content that they felt was sufficient for the cases in those sessions.

Students across the first two years of training were not entirely left to develop objectives and decipher pertinent case material without guidance. That said, the ways in which they were conditioned to limit or frame knowledge became a “hidden curriculum” (F. Hafferty 1998) in which they were indirectly socialized towards sufficient knowing through interactions with fellow students, facilitators, and even the materials they used for MCC studying. For example, at the top of each case worksheet, a “goal” was written by the faculty members,
which contained a general statement about what mattered in the case. Examples of goals from the case worksheets my participants were given include:

(1) GOAL: Understand the risk factors, pathogenesis, and treatment approach for malignant melanoma (Case worksheet, Unit 5, Fall 2017.)

(2) GOAL: Students will describe an approach to evaluating fever in a returning traveler. They will summarize the evaluation of this particular patient, the changing epidemiology of this patient’s infection, and its impact on human evolution (Case worksheet, Unit 5, Fall 2017.)

(3) GOAL: To understand the timing and sequence of the hormonal, cellular, molecular, and anatomic events that lead to male sexual development and reproduction (Case worksheet, Unit 2, Summer 2017.)

In the first unit, newly matriculated after the annual White Coat Ceremony (Craig, Scott, and Blackwood 2018), medical students were so enthusiastic about the bioscientific material related to the cases that they sometimes ignored these goals: even whenever they indicated that the scope of a case was not centered on the scientific mechanisms but rather the population health or ethical implications at play in a patient narrative. During the first unit, medical students were asked to consider these structural and social level dimensions of cases before they embarked on the more bioscientific learning of cellular mechanisms and pathological processes in Unit 2. As Elle, a first year student encountered, overlooking the goal could misdirect students from the intended aims of the case worksheet:
During observations, one first year medical student became frustrated when her classmates had focused so heavily on the minute biological mechanisms of diabetes that they had missed the broader epidemiological discussion of diabetes prioritized in the class objectives. While she said these granular mechanisms would be important in later cases, they were not necessary for understanding the societal and public health aspects of the disease that were deemed valuable that week by the faculty. (Observation notes, week of 8/7/2017)

The first year medical students realized by Units 3 through 4 that these goals directed them towards the official objectives and, by extension, the material on weekly homework assignments and unit exams. As they began to attend more closely to the goals, they used them to steer their studying and class discussion to the general direction indicated by the goal, while using their own, unofficial objectives to isolate more specific factors, processes, and therapies that could relate to these overarching statements. With time, most students had integrated the goal referencing technique for sorting knowledge, and faculty members anticipated that this would occur. Consider these quotes from students and notes from a conversation with a faculty facilitator:

“I don’t find they need to be that specific. I just put, ‘here’s the question I want to ask, and the four organ systems I want to ask about, and take it as you will.’ I feel like at this point we kind of know how to do [the MCC]...We just pick out the important details now and go over those. The LOs can be as broad as you want as long as it corresponds to the goal.” (Natalie, second year medical student)

“Students can refer to the goal in the creation of the objectives. It’s great for how we approach the topic.” (Sadiq, first year medical student)

I talked with the facilitator about the curriculum...He said that this curriculum is an adapted PBL model because students are given a goal for each case, rather than being expected to develop objectives out of the case material with no initial direction or framing given (Observation notes, week of 10/9/2017.)
By following the goal, and by anticipating (or exposing) the weekly official learning objectives, medical students learned how to build their own effective learning objectives that emphasized the core themes of the case worksheets. As they learned to expect what types of information to include and exclude from their weekly studies, they typically relied less on both the case worksheet goals and on the official learning objectives set out by the faculty each week.

In addition to the use of objectives and the case goal to frame and prioritize information, the worksheets themselves acted as tangible artifacts of sufficient knowledge. I noted that the worksheets were self-contained descriptions of a patient case wherein students could not gain more information about the specific patient narrative than what was provided to them on the sheet. Therefore, the faculty members who wrote the weekly case worksheets could be sparing about what details were given and what information was omitted. My medical student participants often made the same conclusion. The faculty’s choice to contain or omit information on the case worksheets was not lost on the medical students, who were calculating about using the worksheets to glean what concepts they needed to focus on in their weekly MCC studies and discussions, even in the first year of their studies:

“The fact they included patient history taking so specifically in this [case worksheet] makes me feel like it will be a question [on the exam],” one student said. The students then list it as a ULO for later study. Even in Unit 1, early in students’ training, they find unspoken cues in the case worksheets and design that would hint at what concepts they could be tested on (Observation notes, M1 session, week of 8/14/2017.)

“We don’t know if this patient is acidotic,” one student said. Another student added, “Or how long she’s been acidotic, if at all. But it’s not in the worksheet. And if they [the faculty] wanted us to learn about it, they would
have put it in there for us to talk about.” The students decide to cut their discussion of acidosis short. (Observation notes, M2 session, week of 4/30/2018.)

The title of the worksheet may be mistyped. The students noted to the facilitator that this could mislead students as to what the case is supposed to be about (Observation notes, M1 session, week of 3/20/2017.)

The case worksheets also provided predetermined limitations for the medical students, who could not yet fully elicit patient histories, perform physical examinations, or make a definitive diagnosis to gather their own information about the patient’s illness. By giving these medical students only the most relevant information in each case for the objectives each week, the faculty minimized the number of possible conditions a patient suffered, and offered a clear, edited account of the patient’s history and therapeutic trajectory. Though this would not reflect the complexities and nuances of cases students encountered in actual clinical practice, the technique of limiting knowledge on the worksheet did lead students to be prudent about what dimensions of a case that they would need to focus on someday to treat patients. The sheets also helped them to narrow what types of information they would need in case presentations: a verbal accounting of a patient’s illness and treatment plan delivered to physicians and clinicians on the wards. Rather than considering only how uncertainty is disciplined out of these presentations (Holmes and Ponte 2011), we should consider how what is brought in to presentations entails omission and ignorance.

While faculty facilitators were present in each class to guide discussion and the formulation of objectives such that they aligned with the official objectives
(which the facilitators have access to in advance), facilitators hesitated to intervene. They were asked by the medical school curriculum leaders to intervene as little as possible, and to offer guiding questions rather than answers if students’ uncertainty persisted. They likewise understood that medical students were expected to develop objectives on their own. The facilitators’ interventions were often in the form of pointed questions or statements intended to guide students to core themes, and to make the most important information in each case distinguishable. For instance, consider the following two cases from MCC sessions:

The facilitator asked what the most common causes of chronic kidney disease are. One student offered a list of a number of causes, including diabetes, hypertension, renal artery stenosis, infections, and polycystic kidney diseases. The facilitator then summarized, “Yes, the first two are the big ones.” “So it’s diabetes first, hypertension second,” a student echoed. “I’m just going to stick with diabetic nephropathy and hypertensive nephropathy,” another student said, as they chose to overlook the other, less common causes of chronic kidney disease. (Observation notes, week of 4/30/2018.)

“Just last week, we had a situation where we had a question about pulmonary hypertension. The logic was very circular, like one factor does this and then that does this which leads to pulmonary hypertension, and we didn’t reach an answer in discussion, so finally our facilitator stepped in and said, ‘all these mechanisms happen at once, let’s move on, that’s not an important detail to know.’ Sometimes other students will do that too.” (Chloe, first year medical student.)

The infrequent intervention of the facilitators was troubling for the first-year medical students at the beginning of their studies. Many students in the beginning of their first year complained to me that they were “paying all this money [tuition] to teach myself,” and they scarcely skipped lectures, where they took notes intently on what the faculty members said. However, by the middle to
end of first year and the beginning of second year, student preferred when facilitators did not intercede in the discussion. In fact, in one classroom observation, a medical student in the end of his first year confessed to me, “I had a facilitator who never spoke and slept through our sessions. He was the best facilitator I ever had.” Other students generally agreed, with some caveats:

“My block 3 facilitator was an old, retired gastroenterologist who talked all the time. I didn’t mind if he was giving clinical pearls [i.e. strong case examples], but I don’t like when he would take the conversation out of scope.” The other students nodded, and one student commented, “Yeah, my block 3 facilitator never talked, which was really nice.” “But we like when M4 facilitators talk!” the first student interjected, laughing. He turned to their facilitator who was an M4, “You give us really helpful information and clinical correlations, so we want you to talk, we just don’t like when older facilitators and the PhDs interfere with the discussion and make us get off-track.” (Observation notes, week of 4/4/2018).

Towards the end of the preclinical years of training, the medical students in my study often believed that facilitator interjections distracted from their own objectives for the case, and that they were able to more effectively develop their own independent aims for studying the weekly cases. In other words, the more advanced students felt a facilitator’s commentary was beyond the scope of the knowledge or context necessary for a case, and they did not often feel the need to defer to the facilitator on what concepts were most important. Once the students developed a more innate sense about what kinds of material to learn and what types of concepts to avoid, they did not feel the need for close guidance, or for facilitator contributions beyond their scope of objectives. Both first and second year medical students believed that fourth year medical student facilitators tended to provide more useful guidance that did not veer into concepts or themes that could be overlooked.
In addition to the interactions between students and facilitators in the MCC, preclinical medical students were also expected to monitor the contributions of fellow students in the formulation of objectives and daily course discussion. Peer moderation allowed students to cut short discussions that were deemed tangential or non-essential to the understanding of a case worksheet, or that did not advance the understanding of the group members. Kady, a second year medical student, said that “once I was a [discussion] leader, and the group went on a discussion of a drug that wasn’t related to the case. I’m candid about that stuff and I said, ‘that’s not productive,’ and others agree.” A fellow second year medical student, Deepak, had devised a strategy for limiting non-necessary conversations in his group. He said, “we came up with a parking lot strategy. It’s when you have a topic you’re talking about, and others don’t find it helpful, they interject and then you can write it onto the board in a parking space, in a little block on the white board. Then you can return to it later if there’s time.”

Throughout observations, I watched on countless occasions as student leaders for daily discussions stepped in and told fellow students that a topic could be tabled or ignored, and heard students apologize for contributing descriptions that were too detailed in the eyes of their peers. Students also self-policed their contributions to discussion in the MCC, largely to ensure that they were not taking too much time or attention to discuss aspects of the weekly case worksheets that they believed to be important. As I observed in a MCC session:

The students then move on to a discussion of the treatments for chronic kidney disease. One student approached the white board to write a comparative chart distinguishing the forms of dialysis: peritoneal dialysis (performed at home) and hemodialysis (performed in the clinic.) He then
began to describe the goals of dialysis and how this treatment functions physiologically in greater detail. “Wait, is this too much, or is this worth talking about?” he paused to ask, and the student leader responded, “No, it’s helpful.” He continued to talk about dialysis at the white board, explaining and diagramming how dialysis removes solutes from the body. (Observation notes, week of 4/30/2018.)

As will be discussed in the next chapter in further detail, teamwork within the MCC (and in the clinical years of training) also shaped sufficient knowledge, in that one team member with less knowledge on a topic could rely on a peer who had more knowledge or experience on a particular disease, treatment, or procedure. However, it is suffice to note here that the team dynamics within the MCC served to place conscious limitations around what knowledge was shared amongst the group depending on the perceived utility of information and its relevance to the students’ unofficial objectives as well as the official objectives.

Across the first two years of training, and even into the clinical years, students likewise learned to turn to study resources that offered more
abbreviated, digestible descriptions of the topics in the MCC, rather than spending more time in textbooks with unnecessary detail. Such resources including brief lecture videos that were about five to fifteen minutes long, which they found online for free or purchased paid subscriptions for through some medical school study websites. Other resources included review books like *First Aid for the USMLE Step 1* (Le et al. 2017) which cut short the lengthy sections in traditional textbooks and offered expedient summaries of the core concepts for each organ system and pathological process. These written resources, like the case worksheets, were also documents that medical students sought to use to indicate the limits around what they needed to know:

One student during check out admitted, “It was just that other students were freaking out about nephrotic and nephritic syndrome, because there is so much on that. I should have just watched the five-minute *Boards and Beyond* video and cut off my studying there, but I didn’t, and that freaked me out because I didn’t know when to stop.” The M4 facilitator said, “Well all you really need to know is that table on nephrotic and nephritic in the Step 1 First Aid book.” (Observation notes, week of 4/30/2018.)

“Oh, yeah, that’s all of medical school,” one female student told me, “Taking a bunch of people who got A’s their entire lives and telling them they have to know enough, not everything.” Another student said, “Like you’ll get 25 sources assigned to read, and you have to decide what out of those readings you need to know, or that you have to know.”

Within the first two years of coursework in the MCC between units three to six, students also learned to consciously ignore information that was not within the thematic framework of that unit: such that the academic calendar was used to gauge what needed to be known, and when, for both testing purposes and for learning within each unit. Sometimes, students would intentionally ignore and
limit their studies on topics that they estimated would be covered in future units, or that had been previously covered in earlier units:

One student began to talk about the immunological dimensions of chronic kidney disease. “There was a lot of immunology in that sentence,” one student laughed. Another asked the M4 facilitator directly, “Do we need to know the immunology stuff for CKD [chronic kidney disease]?” “Yeah, you should know that,” she confirmed, but an M1 student in the group countered, “But we can know that in Unit 5, since that’s when the immune system matters.” (Observation notes, Unit 4, week of 4/30/2018.)

“I don’t know if this is what they want us to do, but we had a lecture in Unit 3 on hemoglobin... maybe we should...” a student trails off, and another student steps in, “I don’t think so, I think we’ll just need to cover flow volume” (Observation notes, Unit 4, week of 3/26/2018.)

A student asks the group if it’s important to be able to tell two different lung receptors apart. “Sounds like Unit 6,” one student said, dismissing the importance of this discussion in the current unit (Observation notes, Unit 4, week of 3/27/2017.)

These instances highlight the fact that medical students regularly engage in knowledge-limiting practices as a way to curb unwanted and unneeded information and to center their focus on information deemed by both themselves and by the faculty to be more significant. By using the academic calendar as a guide, the medical students could sort through information and decide if it was immediately relevant or if it could be strategically ignored and tabled for cases in other units where the knowledge would be more central to their understanding.

As this section demonstrates, the mock clinical course (MCC) serves as an important venue where preclinical medical students first contend with the boundaries they come to place around medical knowledge. These limitations are both self-imposed—in that students decide on their own learning objectives and monitor the contributions of fellow students to discussion—and imposed by the
curriculum itself, whether through the guidance of facilitators more directly, or indirectly through the knowledge contained (and omitted) on case worksheets, through the resources students use to prepare for MCC sessions, and through the comparison of official and unofficial learning objectives. Within the MCC, medical students are socialized to be strategic and, indeed, economical about the scope of information they need for each clinical case worksheet. They are not expected to know it all, but to know enough within the framework of discussion, objectives, and the academic calendar: and in a more implicit manner, to ignore information strategically when it is not needed to advance their understanding at that time, or in that case.

SUFFICIENT KNOWLEDGE IN THE PRECLINICAL YEARS:
UNIT EXAMS, THE STEP 1 USMLE BOARD EXAM, AND TESTABLE TOPICS

In addition to meeting the objectives set out by the group and the faculty for learning in the mock clinical course (MCC), medical students also turned to exams to frame their expectations around what knowledge to master and what concepts or themes to deemphasize and overlook. Throughout this ethnographic study, I charted the shifting relationships between students and their exams from year 1 to year 2. During this time, my medical student participants become less concerned about their medical school unit exams, and more focused on their Step 1 USMLE board exam: as well as the differences between this exam and their unit exam material. The next section, complementing this one, will present three terms that medical students use to characterize the scope of knowledge necessary for exams as well as for class and clinical practice. In this section, I
will also consider what types of information are most likely to be actively ignored or overlooked, which is largely determined by how useful that information is perceived to be in a testing environment. I will conclude by comparing the experiences of my medical student participants with those in Becker et al.'s 1961 study, where medical students were (albeit in a different way) also concerned about the relationships between knowing, not knowing, and exams.

In the first and second year, medical students completed a series of examinations at the end of each of the six units of the preclinical year. In general, students were relieved that exams were not a weekly occurrence and only occurred as final exams at the end of their unit, though this also brought with it the anxiety around remembering all of the cumulative content across the unit. The students came to realize that unit exams did not require them to know every granular biological mechanism, chemical formula, or biophysical process. In interviews and observations, students described the exams as broad and primarily entailing a series of essay prompts rather than multiple-choice questions. Students noted that the ability to write longer responses allowed them to draw on the information they believed to be most important; even in situations where they did not provide the answer the faculty graders hoped for, they often received partial credit for understanding some of the topic or by offering specific examples of related concepts. Furthermore, because all preclinical unit exams were graded on a pass-fail basis, medical students were generally unafraid of missing some content and sought to gain a greater, more integrative understanding of health and disease than to memorize precise facts that might
appear in a more restricted multiple-choice exam with a clear score and only one correct answer.

Because of the conditions of testing at MWSOM, the medical students felt that the unit exams were not structured in a way that would punish them academically for being ignorant of some topics, as long as they knew enough about the important core themes to be able to respond to prompts where they were asked to describe a pathological process and its manifestation in a patient case, or where they would need to outline the functional relationships between anatomical structures. Indeed, as all of the students in interviews indicated to varying degrees, it was better to be consciously ignorant about some topics, and some topics in excessive depth, so that they could have a stronger and more applicable base of knowledge that would appear on their unit exams. As Charlie (second year medical student) described, his exam studying tactics became quite strategic:

“I think that I’ve done a better job of doing a broad-to-deep approach to studying something. Sometimes I’ll even start with something as simple as Wikipedia. And then work my way in to the detailed stuff. Last year I would read *Harrison’s* or *Boron* [denser textbooks], but I would lose the forest for the trees. I can zoom in now.”

He uses the metaphor of Google Maps to describe his studying. “I used to tell myself, ‘turn right, then left, then go straight, then right. But now I can zoom out, and look at the full picture on Google Maps, and say, ‘generally I need to head north.’ That’s how I study now. I don’t get stuck on each step. I try to have a bigger picture of what is going on.”

By the second year, though medical students felt confident in their abilities to master unit exams, they had greater concerns about the Step 1 USMLE board exam that occurred in the Spring after their second year ended early in February.
The Step 1 USMLE Board Exam (Step 1) generated more anxiety amongst the students because it required them to commit more specific, discrete pieces of information to memory that were not as broad or as widely applicable as more general conceptions of common diseases, as I will describe at the end of this section. Microbiology and pharmacology, two core subjects on Step 1, are fields where students must learn specific bacterial organisms and effects of particular medications. Students also had to learn specific formulas or be able to identify sequestered mechanisms of disease for this assessment as well, which proved to be difficult if these items felt disconnected from other concepts they had learned. This made strategic ignorance a more fraught prospect, as students could not overlook minor details or isolated facts that would be significant on USMLE Step 1.

Furthermore, unlike the pass/fail graded unit exams, the scores that medical students received on Step 1 would prove to be instrumental to their future residency applications, and a high score was necessary to place into competitive specialties such as dermatology and surgery. The students’ concern about their Step 1 scores was made clear to me when one second-year medical student introduced me to a study group of second year students at MWSOM called “Project 250,” where the community’s goal was to elevate the average score on USMLE Step 1 across their cohort to 250 out of a possible 300. The medical students chuckled at how intensely the group studied and how seriously they took USMLE Step 1, however all of the students understood that without high scores, they might not advance into their preferred specialty. Angela, a first
year medical student, echoed this sentiment: “Step 1 is very high stakes, and it determines what you do and where you do it. In that sense, it’s like... well, yeah. I don’t stress about things. I would be stressed about [the implications], though.”

The heightened stakes of the USMLE Step 1 exam rendered strategic ignorance a greater concern than in other educational contexts within MWSOM, but students still sought to develop enough knowledge, and the right knowledge\(^1\), for this assessment. This entailed the same decision-making process around what to know and what not to know as they learned through the MCC and unit exams. As Charlie, a second year student, explained to me:

“I’m not feeling too panicked about it. I’m nervous about it, since I think it’s important for the advancement of my career...I want to be knowledgeable, not just know how the test works. And I accept that I need to know the high yield resources to draw the line around what I need to know. You have to triage the knowledge.”

In another instance, medical students in a first-year MCC group in Unit 4 agreed that studying for USMLE Step 1 sometimes meant ignoring correct information for the purposes of the assessment. This strategic ignorance occurred whenever they identified places where the exam itself may not have been updated as frequently as medical guidelines and standards used in clinical practice:

The students then decide to discuss the relationship between hypertension and kidney damage. “But first, what are your guidelines for hypertension?” the M4 facilitator asked. “It’s 180 over 120,” one student replied. The M4 facilitator began to challenge this definition, until another M1 student said that this was the value given to them in lecture. She then listed the lab values for other stages and classifications of hypertension, and the facilitator agreed that these were correct. “It’s just so hard to remember the guidelines that are on the tests, like Step 1, because those are outdated,” a student added, “You have to know what the guidelines

\(^1\) Medical students used the term “high yield” to describe information or materials that would be especially productive for USMLE Step 1 studying. I will expound upon the meaning of this term and others in the next section.
actually are and what the values are going to be for the exams.”
(Observation notes, week of 4/30/2018.)
Therefore, the medical students at MWSOM remained selective about what types of information and resources they reviewed as they prepared for the exam. They carefully differentiated what to know and what not to know based on its applicability to the exam context. Jeremy, a second year medical student, told me that, “there’s so much information on fractures, and on the Step, it’s not that [important.]” Angela, a first year medical student, said: “Like osteomyelitis. People asked why we should know it since it’s not really in *First Aid* [the USMLE Step 1 review book], but it’s common and we will see it on the wards. But most people mean on exams.” She continued:

“The gaps [in my knowledge] will be filled, for the most part. The things I do have gaps in, again, that’s one good thing about Step. It forces you to close the gaps ahead of time. For example, I stop listening when people start talking about blastulas and gastrulas, and I have a [mental] block about that, but I will have to learn it for Step. I’ll learn it when the time comes. There must be some sort of adequate knowledge you need to be a doctor, but there is also an endless amount of stuff you could learn. But there’s some level, or things in a box, of things you need to know. And I could know those things. I could memorize all of *First Aid*, I suppose.”

In other words, the medical students at MWSOM understood that not all knowledge would be valuable in an assessment sense. While they recognized that information on some conditions (here, fractures and osteomyelitis) could be clinically useful, they also strategically overlooked this information whenever it did not have utility for the purposes of the exam. As Angela remarked, medical students sort information by noting what “things in a box” that “you need to know.” This practice constitutes the construction of sufficient knowledge, wherein
medical learning is not just about medical knowing, but about conscious and strategic ignoring of medical knowledge when it is not appropriate or meaningful.

Across both the first and second year of study overall, medical students learned quickly that the content that mattered most for both unit exams and the USMLE Step 1 exam was a more broad, working knowledge of human biology and pathology, and specific examples or formulas only whenever those items would be directly tested on or could be used to highlight a more systemic process in the body. Most often, students focused on diseases and pathologies that were epidemiologically common, such as cancer or diabetes, or clinically significant illnesses like HIV/AIDS, which had sweeping implications for treating and understanding immunology. These types of systemic and integrative bodies of information were also the ones that medical students often held to be most topically important for their exams, as I will explore later in this section.

More specific items of knowledge that students focused on for exams could sometimes have more far-reaching effects as well. Chun, a second year MD/PhD student, gave the example of “Negative feedback. If molecule A causes cascade B and cascade B creates molecule B that impacts molecule A, well, that [process] impacts every organ system. It’s kind of a theme of the body that comes up time and time again.” Rashida, a first year medical student, pointed out “Pressure-volume [loops]. That’s a conceptual thing that you can’t memorize, and in certain pathologies, different things happen that all change the pressure volume loop situation.” Several other students gave the same example, noting that understanding this formulaic relationship had expansive implications for
patient treatment. Medical students felt that they needed to know these types of information, while sparing specific concepts or models that had fewer consequences for a systemic knowledge of health and disease.

Often though not always, medical students would choose to omit social and ethical issues from their exam studies, unless they were directly relevant to a case: for instance, in determining whether or not a treatment could be given to an incapacitated patient whose next-of-kin disagreed on the therapeutic plan, or in understanding the connection between a social history of traumatic abuse and mental illness. One first year student noted to me that informed consent was a topic that repeatedly appeared in their weekly case worksheets, “so I know we will be tested on it.” Further, understanding the legal dimensions of involuntary psychiatric commitment to a hospital was imperative for students in the Unit 6 discussions of mental health care, as I observed:

The students spend the last few minutes of class discussing the legal dimensions of treating mental illness. They noted the legal requirements that a psychiatrist or other physician or psychologist must meet in order to commit a patient against their will for up to 72 hours (“pink slip them”) if they may pose harm to themselves or others (Observation notes, week of 1/29/2018.)

Thus, while these more subjective dimensions of medical knowledge were central to some types of cases, the medical students at MWSOM did not always focus on these types of knowledge. These aspects of medical care were discussed if they were believed to be important to their performance on written unit exams, or by extension, their future physician-patient encounters more broadly construed.
Medical students did not just overlook the social aspects of medicine, however; even scientific and quantitative knowledge could be strategically ignored if it did not advance their understanding of a case or problem that was typical on exams. One student explained in an interview, for instance, that it would make little sense to study histology for a possible exam question on Down syndrome. Medical students explained both in class and in our interviews that they would want to know the epidemiology of a disease to identify whether or not it was a common cause of illness in a patient’s population, whereas they would focus less on the epidemiology in procedural cases where their knowledge needed to focus more on the anatomical and structural factors of how a surgery would repair a specific organ. To medical students, the utility and applicability of knowledge to the analysis of clinical cases mattered more than the perceived scientific or mathematical importance of that information. By making conscious decisions to ignore some forms of information when they were not relevant, medical students generated a leaner and more efficient body of knowledge that was directly applicable for the situation in which it would be needed.

Like the medical students in *Boys in White* (Becker et al. 1961), the medical students at MWSOM were concerned about their performance on exams, both within and beyond the curriculum. Knowing the “right” things for exams constitutes a perennial worry of medical students in North American contexts. However, unlike Becker and his colleagues’ students—who only sought to foresee what the faculty would want them to know—medical students in my study utilized strategic ignorance to whittle down the body of information that they
would study for exams. They honed their own abilities to prioritize and
demeanor information in a range of contexts. By consciously ignoring some
types and depths of knowledge over others, the medical students at MWSOM
developed a keen sense of knowing what not to know, and when not to know. In
turn, this allowed them to overcome at least some of their anxiety about exams.
Bridging the discussion of classroom learning and exams, I will present the
specific and local language that medical students use to characterize sufficient
knowledge in the next section.

HIGH YIELD, LOW YIELD, RABBIT HOLES: ARTICULATING SUFFICIENT KNOWLEDGE

As I was packing my laptop in my bag at the end of a lengthy day in
observations, the second year medical students in my mock clinical course
(MCC) section were giddily sharing their tips for USMLE Step 1 studying. One
recommended flash cards with the spirited enthusiasm that only medical students
can bear towards flash cards. Another student suggested a series of videos
online that summarized key topics. After a few minutes, one of the medical
students turned to me and said, “This is all high yield stuff. Have you heard that
term?” I nodded, confirming, “Yes. I’ve heard high yield, low yield, and rabbit
holes.” Before I could expound any further, one medical student at the table
raised her eyebrows and set her thermos down on the table with an impactful,
metallic thump. “That’s going to be in your dissertation, right?” she asked, though
her tone made the words sound less like a question and more like a polite
demand. She added, “Because that needs to be in your dissertation. All we ever
talk about is what’s high yield and what isn’t.”
I am fortunate to work with participants so willing to assert what matters most about their experiences, and the students in the class session that day echoed the sentiments of all of the 41 medical students I spoke with individually in semi-structured interviews. Medical students, residents, and younger attending physicians at MWSOM—and at other medical schools in North America—commonly use the term “high yield,” while students specifically at MWSOM also employ two companion terms of their own design, “low yield” and “rabbit holes.” In this section I will define each term. I will subsequently offer ethnographic examples that describe how each term encapsulates the way students create boundaries around knowledge, and how they evaluate the importance of some knowledge over other types of knowledge.

The term “high yield” is ubiquitous at MWSOM. Students use the term in discussions and interviews, emails and assignments. “High yield” is not a term of the medical students’ own invention, though they are the ones who ultimately defined it for me. Though the medical students at MWSOM could not recall where they had first learned the phrase, it appears to have been popularized by two widely used review resources for the USMLE Step 1 board exam: the *First Aid for the USMLE Step 1* book (Le et al. 2017) and *Pathoma*, a book an accompanying video lecture series (Sattar 2018). Emblazoned on the brightly colored cover page of *First Aid* are the words “maximum yield” and “high yield facts,” though I could find no direct definition for what these terms meant in the textbook. *First Aid* indicates that “1,300+” of the concepts in its pages are “must-
know,” suggesting—but not directly claiming— that these are items medical students should prioritize for exams.

Similar review resources, such as the Anki Deck (a smartphone application for crowd-sourced medical school flashcards) market themselves using comparable language: “a study published a few years ago showed that the more Anki flashcards students did, the higher their board scores were” ("MedSchool + Anki" 2018). *Boards and Beyond*, a series of brief video lectures summarizing a range of topics, assures that “the content [of our site] is clear, concise, and easy to understand—just what you need to remember all those facts for Step 1,” and that the site will “maximize your understanding” of core biomedical concepts (Ryan 2018).

The vague implementation of the term “high yield” in review textbooks reflected my medical students’ clearer definitions of what the term meant to them. When I asked medical students in our interviews to tell me their definition of “high yield,” all of the students agreed that it meant a broadly applicable or critically important piece of information that could be easily and quickly understood and applied. It could also refer to resources such as review books and video lectures where this type of abbreviated content could be found. As the students explained to me:

“I guess it means something that is both valuable in that it will be in a test or clinical situation, and simultaneously something that will take less time than average material [to learn].” (Charlie, second year medical student.)

“It means something is efficient, that it will be covered and it will be important. It’s a high yield source if you don’t need to spend a lot of time finding the important things” (Brianna, first year medical student.)
“High yield is ultimately important. It has to do with prioritizing knowledge based on how much time you have” (Sadiq, first year medical student.)

“High yield is something that...well, ‘learn everything you need and nothing you don’t.’ That’s high yield” (Bian, second year medical student.)

In all, the students agreed that the term “high yield” indicated that a piece of information was absolutely necessary to know, and that knowing it would “yield” or result in better performance, be it on exams or in the clinic. High yield concepts were not topics that medical students dwelled on philosophically, but instead, consisted of key pieces of information that could be quickly and readily learned and understood within the scope of their existing scientific knowledge.

Resources like books and video series could themselves be called “high yield,” which was the term medical students at MWSOM used to suggest that a resource contained sparing amounts of information and did not exhaustively detail biological or physiological mechanisms that were non-important or uncertain and debated in the scientific literature.

Nishad, a first year medical student, explicated: “High yield means it’s likely to be a topic of examination. And resources for high yield [knowledge] are Pathoma, First Aid, Firecracker, Sketchy [the latter two are computer learning applications.] They’re more summarized, which is why they are high yield. Textbooks go into a lot of detail and background, like historical information. The chapters aren’t developed in a way intended to be high yield. It’s an inefficient way of delivering knowledge.” In this way, medical students at MWSOM would call resources “high yield” if they gave a digestible summary of information that was most critical to learning. Many students used these “high yield” resources in
addition to traditional textbooks that contained greater detail and nuance, however they preferred sources that eliminated the noise of information that was not necessary to understanding an overall disease or physiological mechanism.

Alternatively, medical students used the term “high yield” to indicate that a particular theme, concept, or formula was especially important and worth committing to memory. As I noted in the section on exams in the preclinical years, pressure-volume relationships in cardiology were held to be a key concept that would have applicability in a variety of disease contexts, and students thus stressed its importance. Other students felt that chronic illnesses were “high yield,” given that they would be clinically common in practice and the management of chronic illness required them to understand more systemic and overarching physiological concepts. As I will note again on the upcoming discussion of “low yield” knowledge, specific formulas or obscure diseases could also be classified as high yield if they cued students into a relationship between organ systems, especially if they served as efficient examples of complex processes that made these difficult ideas more easily accessible.

In addition to applying the term “high yield” to resources and concepts, the medical students at MWSOM recognized that knowledge that was “high yield” for one arena of training was not always the same for other venues. Information could be high yield for “the curriculum” (weekly assignments, discussions, and unit exams), high yield for USMLE Step 1, or high yield for clinical training on the wards. “For me, what’s high yield is what is relevant for clinicals,” Zara, a second year medical student, commented, “[I care about] differentials, or ordering tests.
For other people, high yield is more related to Step 1. For me, it’s broader, it’s about setting myself up for the future, what will be useful. For me, anything that has to do with a disease process is high yield, and if it will impact one patient [it matters.] Anatomy is a huge high yield area. It’s very relevant in daily life.” Other students agreed that information that would be high yield on the USMLE Step 1 exam such as specific drugs, microbiological organisms, and formulas might not be applicable once they arrived on the wards as clinical medical students. That said, many students were firm about what types of information they prioritized across venues. “High yield to me is what is important for understanding and connecting all the diseases together,” Amy, a first year medical student, told me, “A specific symptom or lab value might not be important unless it helps me connect them together.

While locating high yield concepts and resources enabled medical students to study more effectively and with greater focus, they also recognized that the process of determining what was “high yield” was often problematic. For instance, many students in both observations and interviews confessed that the high yield review textbooks for USMLE Step 1 sometimes gave descriptions of processes and diseases that weren’t detailed enough. The students used these texts to establish a general understanding before seeking more specific and complex information when they felt it was warranted. Furthermore, the second year students who I interviewed often groaned when I asked them to talk about what “high yield” meant. They expressed frustration around having to decide what information was most important and what information to overlook, and said
that some study resources like *Pathoma* called so many pieces of information “high yield” that differentiating the truly critical material became impossible. Other students said that focusing so intently on high yield information excised the joy of learning-to-learn from their medical school studies. However, even these intellectually minded students recognized the need to limit their acquisition of knowledge, given that they were “drinking water out of a fire hose,” a phrase that both Amy (first year medical student) told me and that appeared in Poirer’s analysis of medical student and physician narratives (Poirier 2009).

![Figure 6](image)

*FIGURE 6: A meme poking fun at high yield exam questions (“Professors Pulling the Classic High-Yield Switcheroo” 2018).*
Medical students at my field site often referred me to Internet memes, usually in the form of a comic, that they sourced from medical student forums online. They used these images to cue me into their experiences and to laugh about the shared frustrations and pitfalls of having to limit and bound knowledge as “high yield” across different contexts. Here, I have included two of these “high yield” memes.
yield” memes. The first (Figure 6, above) pokes fun at the way that faculty might mislead medical students about what information would be high yield for exams in a “switcheroo” (“Professors Pulling the Classic High-Yield Switcheroo” 2018).

The second image (Figure 7, above) illustrates that preclinical medical students can become so focused on textbook knowledge that they fail to understand its clinical relevance or application (“Heart Attacks and Book Knowledge” 2018).

The term “high yield” reflects medical students’ socialization towards sufficient knowledge, in that it indicates some knowledge is critical and should be prioritized over other kinds of information that will “yield” less results, be it in the form of top-level test scores or strong academic performance in the clinical space. As students actively weigh what information to know and what information to ignore, high yield concepts received the greatest focus. While some medical students were critical of the need to focus more exclusively on high yield concepts or resources, they nevertheless acknowledged that this process of sorting information based on applicability to exams and training was necessary given the amount of biomedical knowledge they could never fully master. In conjunction with the term “high yield,” students developed a companion phrase—“low yield”—which I will outline in the next section.

“High yield” knowledge consists of the content and sources that medical students opt to strategically know, but “low yield” entails the concepts and materials that medical students recognize, decide is unimportant, and intentionally choose to ignore. As medical students defined it, “low yield” typically refers to a specific, isolated piece of information that will not be valuable in
exams or clinical practice. It can also refer to a learning resource that is densely written, and does not advance an integrative understanding of human health and disease quickly through abbreviated explanations. Medical students in my study defined low yield and gave examples of low yield knowledge in these ways:

“I was suggesting we do a question once, and someone said that it was ‘low yield,’ and it was the first time I’ve heard it. It’s what people don’t want to prioritize. Embryology is low yield. I really like it, but some people argue, ‘why do you need to know the names of the different parts if by the time you’re born they’re gone?’ Which is true to some extent” (Angela, first year medical student.)

“Low yield is statistics, because they change depending on what source you use. Things that resources and research differ on, where there’s no answer. And another is common symptoms. To differentiate between diseases, you want to know what symptoms relate only to one disease. A lot of diseases present with fever or muscle pain or whatever, and it [doesn’t help to differentiate.] Another low yield thing is guidelines, or very specific calculations for things. Or knowing all the different types of fractures, that’s low yield. If you need to specialize to understand it, that’s low yield for me right now, because I don’t need to know that right now. It’s so low yield for me to know things beyond the main action, or the major action, or side effect. Low yield is [sp.] things that are not commonly occurring.” (Amy, first year medical student.)

“Like genes, that’s not high yield. I don’t need to know them, unless I’m going into oncology. You don’t need cell signaling. It might come up in Step 1, but not in [clinical] practice. Step 1 emphasizes pathogenesis. Pharmacology is on there too. Physicians don’t consult pharmacologists that much so I have to know it. Microbiology is something I can always look up. There are a couple of strains of bacteria we see a lot, and the rest we rarely see” (Bian, second year medical student.)

“It’s easy to find low yield stuff. I can’t even remember a low yield example because it’s low yield” (Nathan, second year medical student.)

In sum, if high yield studying is an epistemological process of prioritizing knowledge, then low yield learning is the agnotological process of deciding what information is peripheral, unnecessary, and can be forgotten or overlooked.
As I noted earlier, medical students at MWSOM frequently shared internet memes from online medical school forums with me to illustrate their experiences. The next image featured in Figure 8 (“If It Ain’t High Yield They’re Fucked” 2018) is amongst the ones that they felt highlighted the phenomenon of “low yield” knowledge. In the meme, a physician remarks that he is unprepared to help a patient whose disease was contained in an “optional” chapter, one that was presumably skipped because it was deemed irrelevant. As one anonymous forum member commented on the discussion board below the image on the same web page: “It’s their own damn fault for getting a low yield disease.” It was not clear if this person was a student at another medical school (signifying that
“low yield” is a widely-used term), but the image and accompanying text nevertheless highlight the ways in which preclinical medical students prioritize and de-emphasize knowledge.

At Midwest School of Medicine (MWSOM), the medical students agreed that low yield knowledge or resources primarily took four forms. In the following numbered sections, I will define each type of low yield knowledge and offer ethnographic examples of each, drawn from interviews with medical students.

(1) The first form is granular: knowledge that is so specific and detailed that it would not advance a more systemic understanding of how bodily systems are implicated in disease and how treatments operate. “If I’m just reading a lot of equations, I will check to see if something is in First Aid,” Deepak, a first year medical student, explained, “If not, I can skip it, unfortunately. But you get the sense that there’s just too many details.” Natalie, a second year student, commented, “There’s so much to know, so many drugs and bugs. How much do I really need to know, and how much can I Google as a doctor on the go? Why do I need to have it in my head? It’s a waste of brain space and cognitive function and time. The acute stuff and the common things you need to have stored in your head, but that’s it, really.”

(2) The second form is knowledge on diseases or conditions that are so obscure or rare that the likelihood they would be seen on exams or in the clinic meant that students could usually overlook them; as Natalie in the section above indicated, the “common things” or diseases are the ones most worth knowing. The exceptions to this categorization were rare
diseases that were helpfully illustrative of the relationships between organ systems. Priya, a second year medical student, explained that, “there’s DiGeorge syndrome, which is really rare, but it creates a whole range of symptoms that don’t seem related, even though they are. So one aspect of your health can change everything about your life, even if something like that will never be clinically [common.]”

(3) The third form of “low yield” knowledge is uncertain or debated scientific concepts, which medical students typically and consciously omitted from class discussions and from exam studying. Students did find it instructive to note where there were clinical unknowns or gaps in the literature: for example, “the students noted that there was a ‘lot of debate’ on the mechanisms of the luteinizing hormone (LH) peak in menarche” (Observations, week of 9/11/2017.) However, they did not dwell on the range of possible explanations or the scientific principles of these various speculative theories.

(4) The fourth form is information that is simply not highly relevant for either exams or clinical practice. “A lot of Unit 1 is low yield,” Kady, a second year student, confessed. Unit 1, which addresses biostatistics, population health, and some ethical issues like medical errors, is not considered by the students to be as applicable to clinical problem solving as other knowledge like pharmacology, pathology, or anatomy. Some students also overlooked embryology, which they viewed as unnecessary for the overall medical knowledge required of most clinical specialties.
Medical students were quick to tell me that “high yield” and “low yield” concepts were dynamic, and what would be “high yield” in one situation would be “low yield” in another. Preston (second year medical student) told me that, “sometimes [physicians] will say, ‘this wasn’t on Step but I see it all the time,’ or, ‘I never see this on the wards but it was huge on Step.’ Like injuries. Injuries, like nerve injuries, are all over Step.” Ellen, a first year medical student, told me:

“All the panic and uncertainty at the beginning of medical school comes from differentiating high yield from low yield, and there are different contexts in which something is high yield. Like today we were talking about lung physiology, and at how the base of the lung there are more gravitational effects. In asthma, the top of the lung acts like the bottom of the lung due to inflation, so if you push fluids, it increases blood flow and forces the airways down. The facilitator said that it’s high yield, but it’s only high yield for clinicals, not Step 1.”

Here, medical students understood that the way that they categorized information based on its perceived importance and utility was not fixed, and that while it was imperative to decide what information to strategically ignore, these overlooked knowledges were not permanently forgotten if they mattered in another scenario.

The pursuit of non-necessary knowledge itself struck medical students as detrimental in other ways. While falling “down the rabbit hole” might have fantastical connotations for children’s storybooks, the phrase is not one that medical students are endeared to in the content of their training. Medical students defined “rabbit holes” as instances where they studied an isolated mechanism or disease process to such depth that it was no longer useful, and had taken up precious study time that could have been better applied learning more important concepts. Rabbit holes, like low yield knowledge, could also consist of debated scientific theories or unknown phenomena, if those topics
became so debated within MCC groups or study communities that they detracted from more critical topics after extended inquiry. The following quotes from interviews with medical students highlight the ways in which they explained rabbit holes, and how they related “rabbit holes” to “low yield” concepts:

“I would say a rabbit hole is something that is really granular, and goes really in depth, and it can be a rabbit hole because it takes away from the discussion. It could have been a rabbit hole to talk about some weird, experimental theory... It just means you’re spending too much time on it. Low yield is something you’re not going to need for Step, or third year.” (Preston, second year medical student)

“Rabbit holes would be spending way too much time on a topic that is not important or there is no answer for...I’m candid about that stuff and I said, ‘that’s not productive,’ and others agree. They know what’s high yield, for both boards and for clinic. If it’s a rabbit hole, it’s low yield.” (Bian, second year medical student.)

“You can never study enough for MCC. You could read everything, and you wouldn’t know every detail. But if you can go through the case and answer every question on a second read through that’s enough. Maybe that’s not how it works in the real world, but it’s fine. Sometimes I’ll ask, ‘if I missed something, is it easy to find?’ If so, it’s important, and I just missed it. If not, it’s a rabbit hole. If I need to read two primary [research] papers to get something, it’s a waste of time. And sometimes the greater medical community just doesn’t know, so I guess I don’t have to know either. That happened a lot in rheumatology” (Imani, first year medical student.)

Charlie, also a second year medical student, defined “rabbit holes” by distinguishing them from “low yield knowledge.” To Charlie, rabbit holes were primarily characterized by the manner in which they appeared to waste students’ time, whereas low yield knowledge was not necessarily characterized by the amount of time taken to learn it. Rabbit holes were an experience of pursuing a depth of knowledge, not an isolated fact or resource with little perceived value or utility on assessments. He told me:
“Both are negative terms because of the opportunity cost, but a rabbit hole is something you spend time on that may not be worth that high time investment. But low yield is not worth the time at all because it won’t be tested.”

Yet other students viewed rabbit hole and low yield as compatible terms. For instance, another second-year medical student described low yield knowledge and rabbit hole pursuits of knowledge in close conjunction during interviews:

“If it’s a rabbit hole, it’s low yield. They’re the same. Unless a rabbit hole is something that leads to an answer that we didn’t find before or that we missed” (Natalie, second year medical student.)

Across the students’ responses, it became clear that a “rabbit hole” was a discussion or a trajectory of studying that spiraled deeper and deeper into obscure content that would not ultimately improve the medical student’s understanding of a disease process or of healthy biological function. Rabbit holes consumed time, energy, and focus without “yielding” results in the form of high exam scores or improved general understanding. From an anthropological standpoint, rabbit holes reveal the ways in which medical students become sensitized to the scope and depth of knowledge that is necessary, and to the types of content that can be consciously ignored.

Medical students encountered rabbit holes frequently in the first few units of training, when they were not sure what level of depth and scope to acquire in their studies for the MCC and for unit exams. They also tended to expound upon what they found in their weekly studies such that, on occasion, the discussion became a diatribe about an aspect of the case that the group was not interested in learning more about and wished to ignore or pass over. As one first year medical student (Ellen) reflected:
“In Unit 3 we had a lot of rabbit holes. We had a MCC member who was interested in infectious disease, and so when those [diseases] came up, it became a rabbit hole. If we had time for it, we would let him share, because it was never boring. But it comes to time, and I’ve had to cut people off from rabbit holes, and cut myself off from rabbit holes in my own research. I can tell I’m on a rabbit hole when I’ve been talking a long time [in class] and other people are politely smiling.”

As the year progressed, students were more wary of rabbit holes, and more adept at cutting rabbit holes in conversation short whenever someone began speaking on topics to a level of detail that was not instructive to the group, or instructive for the purposes of exam. Like with low yield knowledge, medical students openly commented about the utility of knowledge to their peers, and limited their own contributions to discussion if they felt the information they wanted to offer was not a priority to themselves or others.

Some students also imposed new frameworks on their individual study practices to limit the possibility of studying the material too deeply. One tactic that students used was to set a strict time limit on how long they had to study each weekly case worksheet in the MCC, which made them more mindful of the scope of information they were developing on each case. Other students tried to stick closely to their weekly unofficial learning objectives, which provided convenient goal posts for what types of information and depth of information were deemed necessary for each case by the group. If students missed a more detailed concept in their weekly studies that was noted in the official weekly objectives posted by the faculty, they could return to their textbooks and learn this new concept within the broader understanding they had already developed on that particular case.
Students with existing graduate degrees in the sciences, as well as MD/PhD dual degree students with research experience, were often accused of going “down the rabbit hole” most frequently. While students in the MCC group could turn to these individuals for specialized assistance in their fields of study, they were also wary that this highly specialized scientific knowledge could misdirect the overall trajectory of the case discussion. This reputation was understood as the product of research culture, wherein bioscientists would want to know the more precise chemical or physiological mechanisms in their field, or the debates in the field about phenomena for which there was no existing explanation but many possible hypotheses. Yet non-scientist students with passionate and particular interests were similarly criticized by peers for entering into rabbit hole discussions in the MCC. Consider Ellen’s (first year medical student) anecdotes about rabbit hole offenders:

“In this unit, we have a girl who’s really interesting in cardiology, and she’s seen a ton of really rare congenital illnesses in India where she shadowed, since people there couldn’t get access to care to fix [those illnesses] earlier. Her clinical experiences are very interesting and provide a really good clinical context, but she’s susceptible to going really into detail in MCC. Which if you want to do that on your own, that’s fine, but MCC isn’t about your individual interests. Now that we know what’s high yield and low yield, it’s selfish to take the group’s time. You can note the clinical correlation without all the details. So we gave her feedback, saying we liked the context, but it’s limiting our ability to get to all the topics we need to in MCC, so be careful than the depth, because medical school is more about breadth than depth. No matter what block you’re in, you’re going to have someone who’s really jazzed about the material and wants scientific detail. But you need to limit yourself based on the group’s time.”

Ellen continued: “We had a MD/PhD student in Unit 2 who used to go into that level of detail, and goes into detail in her notes, but she doesn’t go into that level of detail in class and she focused on the high yield stuff. And one of the students in my Unit 3 group already had a medical degree from Ghana, and so he wanted to learn things he already knew to further depth.
It’s not a detriment to go into a rabbit hole, unless you’re taking away from the team, and you need to moderate whether you bring up the rabbit hole in MCC.”

Like in the case of low yield knowledge, some students did feel that rabbit holes allowed them to freely pursue topics that they found personally interesting in their individual studies, as Ellen’s descriptions above indicate. That said, the same students cautioned that rabbit holes should not detract from the central threads of discussion in the MCC, where individual interests could compromise learning of the main themes by other members of the group. To the medical students at MWSOM, while rabbit holes did indicate the freedom they had to study content that they individually found fascinating, it was most important to curb these explorations and focus—both individually and as a team in the MCC—on topics and processes that were more pressing.

Therefore, the rabbit hole becomes another epistemological and agnotological site—in addition to cases of both high yield and low yield information—where students actively limited the types of knowledge they studied and learned. These classificatory terms reflect the ways in which medical students categorize knowledge based on its utility and importance, and on whether or not it can and should be overlooked. While “high yield” and “low yield” are neatly opposed terms, students sometimes described rabbit holes as “low yield” whenever they drew them away from the content that was most “high yield” for assessment and future clinical practice. By understanding these localized terms, it is clear that medical students in the preclinical years think critically about the frameworks they use to filter or forget medical knowledge.
SUFFICIENT KNOWLEDGE IN THE CLINICAL YEARS: FRAMING KNOWLEDGE FOR PRACTICE

Students in third and fourth year continue to engage in sufficient knowledge practices, and physicians also understand the importance of prioritizing information and bounding knowledge for practice. In this section, I will account for fourth year medical students’ experiences of sufficient knowledge, and what I discovered regarding the bounding information within clinical spaces. Drawing upon their habits of limiting and prioritizing information in the preclinical years, clinical medical students learned how to adeptly study and practice on the hospital wards. They were also confronted with new challenges that lead them to reevaluate the scope and content of their knowledge as it pertained to clinical training, namely through three experiences: “pimping questions” by attendees, patient case presentations, and encounters with the social and material constraints on practice in inpatient and outpatient settings. This section will overview each type of experience, and explore how sufficient knowledge emerged as a theme across fourth year medical students’ accounts of clinical learning.

One hallmark experience that third and fourth year medical students undergo is “pimping,” a process wherein an attending or advanced resident poses difficult and often highly specific questions to the medical students he, she, or they is training (Wear et al. 2005; Detsky 2009). Pimpering is undoubtedly psychologically and academically stressful for medical students, but it also highlights the ways in which students’ understanding of the prioritization of knowledge is challenged and reframed. Indeed, when I asked one of my fourth
Nikhil, the fourth year medical student who asked me to address pimping in my dissertation, made it clear that the anxiety around this process was that the questions attendings asked in these scenarios were so obscure or specific that they felt unanswerable. These questions also did nothing to showcase the huge amount of knowledge that medical students in the clinical years had, indeed, learned in preparation for their rotations through different specialties. In a conversation with Nikhil, he made these challenges clear to me:

On a pediatric surgery rotation, Nikhil was asked a very basic science question that he wasn’t prepared to answer, and had to stumble his way through a response that did not seem knowledgeable. “I knew some things, not all the things,” he said, but “in the moment” he felt that he “looked bad,” and like he knew nothing about what he was questioned about (a process called “pimping.”) Even though the resident said it was not a big deal that he didn’t know, he felt terribly about it. He said that the perception of him by residents and attendings is really important, and he feels pressure to “seem prepared.” He described not knowing as a “sign of weakness.” After reflection, however, he added that this situation was marked by “unfairness”: why didn’t the attending ask about one of the many things he did prepare for? In final assessment, that attending actually said he was knowledgeable and he was graded well, suggesting that he had in fact been knowledgeable and prepared.

Jiao, a fourth year medical student, told a similar tale. She too felt frustrated by the specificity of pimping questions, which undercut the substantial body of more broad knowledge that she had mastered for each of her clinical rotations in the hospital. Thus, the material that she and Nikhil found to be sufficient enough to perform well in rotations mattered little, and differentiating what information to prioritize was impossible in the face of pimping questions with
called for such obscure or granular knowledge. Having already matched into the highly competitive specialty of her choice, Jiao was less concerned about the process of pimping in fourth year, though nevertheless felt these frustrations:

“For me, I've gotten to the point where I don't care [about pimping.] What are they going to do to me? Today I got pimped, and I thought, I'm not going to see this person again, and I was on a different team with anesthesia any way from the person who asked the question. In third year, it made me nervous, because my grades depended on it, on this esoteric knowledge. But I rationalized it as, 'I'm here to learn, if I knew everything I would be an attending.' You could work hard for a whole month, but you get so little time with an attending, that if they ask you one question in an entire month and you get it wrong, that changes everything. And sometimes they have a specific answer in their heads that you can’t get it from a textbook any way. It’s a high-stress thing.”

Heather, also a fourth year medical student, reflected on her third year surgery rotations in a similar way. Like Nikhil and Jiao, she felt that the specificity and obscurity of the questions she was asked as a medical student made it impossible to anticipate what to know and what not to know. Heather explained that:

“In surgery, they’re big on pimping questions, because you’re sitting there working on someone’s body and all you can do is answer questions. I had an endocrinology surgery rotation, and the attending kept asking all these questions and I didn’t understand what she wanted. It was uncomfortable. I couldn’t even answer her questions because they were so specific that I couldn’t even make up an answer. With her, she asked me about one kind of disease and I offered something, and she said ‘no.’ But it was a possibility, so I could have been right, she just decided I wasn’t... That’s the hardest part. You don’t know what they want you to know. I can study in preparation, but not if I don’t know what you’re going to ask me.”

Beyond the personal difficulties of these types of encounters, pimping presented a challenge to the expectations that medical students had developed around sufficient knowledge. The esoteric or isolated pieces of information that they might once characterize as “low yield” were instantly made critical, and their
ability to explain broader connections between organ systems or to offer more pressing answers about common or acute conditions went unnoticed. While these instances did not necessarily determine a student’s marks in each clinical rotation, students nevertheless felt worried about them as signifiers of their ability to “know” effectively. Pimping did not necessarily change medical students’ sufficient knowledge practices: which, as I will explore in the next chapter, physicians engaged in as well. But pimping questions did make students especially wary of the ways that they drew limitations around what to know.

Beyond pimping, medical students in the clinical years also encounter new ways that knowledge becomes prioritized through learning how to deliver biomedical patient case presentations. As Holmes and Ponte (2011) have previously observed, uncertainty is carefully “disciplined” from these highly structured patient accounts, as medical students learn to craft more certain depictions of what is happening in a biomedical sense to the people in their care. However, case presentations simultaneously require medical students to intentionally ignore and omit certain types of information, and the clinical years of training are a key site where future physicians learn to curb knowledge shared with their team (and, in turn, focused on in their own case studying.)

Heather, fourth year medical student, modeled what information she prioritized for the case presentations based on the way that attending physicians seemed to approach their cases. Some forms of information that were typically non-essential could prove to be useful, but she only prioritized these forms of knowledge under certain circumstances. Heather told me:
“I would take the first day or two [on the rotation] to see what the physician prioritized in presentations. Some people want the whole thing [i.e. all aspects of the case], and others want only specific parts. Some want the social history and some don’t care. You have to look at the higher-ups to see what they want. I would focus on things I’ve never seen before to fill in the gaps of my own knowledge. And what kind of things get left out? The social history, and the family history. Often it’s not as important, but sometimes it can be really helpful, especially in weird cases that don’t make sense. The soft sciences part is the first to go. But in psychiatry, they will focus a lot on collateral information, like a social history or family history, and how this person behaves outside of the hospital.”

Kyler, a fellow fourth year medical student, also noted that it was important to decipher what types of information mattered to different attending physicians. He said that part of his anxiety in third year rotations was “knowing the correct answers and communicating knowledge across a group of people who has all use different resources.” He tailored his case presentations to specific attendings, but added that even experienced physicians on the ward were not “pinnacles of knowledge.” “I know that they’re pulling some stuff out of their ass,” he assured me. Kyler felt that even if he made mistakes, he knew how to navigate the needs of particular clinical professional teams, and adapt the content of his presentations accordingly.

Fourth year students were also quick to pass on their advice for what to include and exclude in case presentations to first and second year medical students. As facilitators in the mock clinical course (MCC), they asked students to present the cases described in the worksheets and then gave feedback on these verbal presentations. The facilitators described the specific formats that medical students should use in an effective case presentation, as well as what information would be extraneous. For example:
Today’s session begins with a case presentation by the student leader for this session. The student overviews the symptoms and exam results for a female patient in her 50s who has lung cancer. After the presentation, the M4 facilitator commented that the student had added a summary of the case at the end of his presentation, but that this would not be necessary on the wards and could be cut “for time.” The student replied that the template his classmates found for case presentations stipulated a summary, but that it was helpful to know that this wasn’t required (Observation notes, week of 4/14/2018.)

In other instances, fourth year medical students recommended the appropriate types of information to dismiss for each case. This could entail omitting or limiting social history for a surgical case, or gleaning over lab values in the case of a traumatic injury where these values weren’t as central as they would be for an internal medicine case. As I have outlined, fourth year medical both learned how to omit information from their presentations and instructed less advanced medical students on the same sufficient knowledge practices.

Fourth year medical students also learned that the clinical environment posed new practical limitations and frameworks around sufficient knowledge that had not arisen in the preclinical years. For instance, one fourth year medical student, Harini, noted that she needed different types of knowledge for the outpatient clinical setting versus the inpatient setting: “You get more variety in the outpatient setting and so you don’t always know what’s going on. In inpatient [care], you see the same common diseases, like pneumonia. And you know what to do with that.” Another student remarked that, as a member of the clinical professional team, she was required to have a scope of knowledge that differed between her, the resident physicians, and the attending physicians:

“I think that each person on the team has different roles and responsibilities based on what they should know. Like I would know more
detailed stuff like lab values for each patient, whereas the higher up the hierarchy you go, the more you focus on the bigger-picture things and managing the patient’s progress. I knew the scope of things I was responsible for, and I don’t think there was much overlap between what I knew and what residents and attendings knew. We were on the same page, though, because that’s the purpose of rounding. The interns are responsible for day-to-day things that happen to patients, while the senior resident keeps track of all the patients and their general well-being, while fellows and attendings are supposed to make sure the patient is getting to their end point, like admission or the next step of treatment” (Emma, fourth year medical student.)

Other students remarked that within the role of medical student, they filled a unique epistemological position on their clinical care teams that impacted the scope and depth of their medical knowledge. Nikhil, fourth-year medical student, reflected that as a trainee, whose primary purpose for being in the clinic was to learn rather than practice, he had more time to interface with patients and to study their cases. This allowed him to provide information about the patient to his colleagues that they otherwise may not have had. In one case, he told me that he was able to dismiss the possibility of dementia for an older patient who was asking about his farm: indeed, he told the attending physician, the man was not experiencing a delusion and wanted information on how his farm in a neighboring rural area was faring in his absence. Further, because medical students were tasked with presenting patients (as noted earlier) they often knew about their assigned cases in greater detail and provide additional clinical context when it was needed by other clinicians. While medical students sought to have a broad understanding of human disease and health, their specific knowledge on individual cases also became a form of particularly useful knowledge in the clinic.
Though fourth year medical students could often provide a deeper narrative about the patient than other clinicians on their teams, there were typically too many patients to tend to for them to focus this intently on everyone they saw in the clinic. The students readily admitted that they sometimes did not have the time to fully study each patient case that they encountered, and that they relied on residents and interns to suggest questions that would guide their studying to more specific questions. As I will outline in the next chapter, the fourth year medical students learned that time is an unavoidable and important constraint in the way knowledge is both developed and limited. Information that is intentionally ignored in the clinical space is often due to time constraints within that environment of practice.

Medical students in the clinical years often learn about other difficult realities of clinical practice that can limit (intentionally and unintentionally) how much can be known about a patient. For instance, patients lost to follow-up appointments had incomplete medical records, which made it more difficult to piece together their disease progression. EMR (electronic medical record) and EHR (electronic health record) systems also limited what types of information they could access on or record about a patient, as other scholars have also noted (Hunt et al. 2017). Communicating information across clinicians in a department or on a team was also a challenge and, inevitably, some information was lost in the busy, daily scramble of clinical care delivery.

Other daily practices similarly altered student’s experience of sufficient knowledge. Kyler, a fourth year medical student, learned that the practical
constraints of surgical note taking imposed new restrictions on the types of knowledge that were necessary in the clinical environment. As I describe in notes on our conversation, he said:

He didn’t know how much information would be necessary for the surgical team regarding the patient, so he copied all of the information listed for the person, without knowing what bits of information were unnecessary. The residents corrected him and explained that they did not need every value on the charts copied to their files for the surgery, and taught him which pieces of information should be transferred. “I had no way of differentiating” what information was useful and not useful for patient care, he concluded, until they explained this.

In these ways, fourth year medical students in the clinical training years continued to contend with the necessary and inherent limitations placed around knowledge in biomedical practice. Through pimping questions, patient case presentations, and learning the constraints around daily clinical practice, medical students were sensitized to new boundaries around knowledge and had to develop novel ways of making sense of these limits. For fourth year medical students, calculated decisions about what to know and what to ignore shaped their clinical training experiences, and echoed their socialization as preclinical medical students tasked with navigating the epistemological rifts between knowledge and ignorance.

SUMMARY

In this chapter, I have presented ethnographic data from a multitude of educational venues that supports the argument that physicians-in-training make conscious choices about what to know and ignore based on the usefulness and instrumentality of that information in numerous contexts. I found that for preclinical medical students, the mock clinical course (MCC) and exams are the
primary venues in which sufficient knowledge practices emerge. Medical students at MWSOM developed their own language for distinguishing knowledge based on its perceived importance, though these local typologies were hardly fixed, and depended on the context in which the student sought to apply the information. For clinical students on the wards, pimping questions, patient case presentations, and the daily practices of clinical labor provided the most meaningful frameworks in which to situate information as either worth knowing, or worth forgetting and ignoring. As I will explore in the next chapter, there are many factors that shape sufficient knowledge that exist in both the preclinical and clinical spaces. As medical students in my study reveal, these factors are mirrored in medical practice: demonstrating the lasting significance of sufficient knowledge for physicians long after they have graduated medical school.
CHAPTER 4: Factors of Sufficient Knowledge

INTRODUCTION

As I have demonstrated, the social and pedagogical environments of medical training are structured in a way that orients future physicians to sufficient knowledge. The design of contemporary medical school curricula, as exemplified at my field site, implicitly socializes trainees to make choices that limit and focus relevant knowledge. While the curricular environment plays a significant role in students’ changing relationships to knowledge and ignorance, however, sufficient knowledge is not simply an educational outcome. In this chapter, I will argue that there are other variables at work that shape what types and scope of information are strategically known and ignored. My ethnographic research has revealed that the variables of time, specialization or granularity, teamwork, and accessibility of information and material resources are key factors in the social construction of sufficient knowledge. Specifically, I contend that decisions to ignore information are influenced by (1) the amount of time someone has to gather and study the pertinent information, (2) the accessibility of information, be it readily available online or more remote and requiring memorization, and accessibility of material resources, such that what is known or ignored reflects the materials one has available to execute the clinical treatments that they know in a conceptual sense, (3) the specialization or granularity of focus that one has adopted that draws a particular boundary around the types of information focused on, and (4) teamwork or the ability to rely on colleagues whose knowledge may supplement gaps in another practitioner’s understanding,
Some of these factors have been previously described or alluded to in existing sociological and anthropological literature of biomedicine. That said, these variables have not yet been systematically identified in relation to the decisions that clinicians make when it comes to filtering and bounding knowledge. Thus, this chapter seeks to open a new scholarly conversation on the ways in which various practical and social conditions transform what kinds of information about patients’ cases are omitted or centralized. Scholars who study the knowledge and ignorance practices of other trained professionals and experts, I believe, will find this chapter an especially useful resource. In it, I will consider variables that have as much relevance to medicine as they do to other fields; for instance, in the sciences, limited grant funding impacts the scope and specificity of a project that cannot be so expansive that it requires time and material resources that are unavailable to the researcher.

While I believe this chapter initiates these types of discussions, here I will focus specifically on the impacts of the aforementioned factors in biomedical training and practice. The factors I have identified influence what choices that medical students—as well as their physician mentors—make when deciding what information is critical and what information is peripheral or non-necessary. Moreover, these factors can and do overlap in important ways. This chapter will draw once more from my ethnographic interviews and observations with medical students and their physician mentors. From this evidence, I will again argue that the undergraduate years of medical training, especially in the preclinical stage, are reflective of the conditions of later-stage physician practice. Medical students,
like physicians, contend with similar restrictions placed on their knowledge by all of the factors named above. In order to illustrate how the environment of medical training mirrors medical practice, I will draw on data on both preclinical training and later-stage clinical training and practice. As I will emphasize throughout this chapter, the preclinical years of training may serve as an important site for considering how the day-to-day responses around knowledge and ignorance are carried through into medical practice.

TIME

As my ethnographic research reveals, time is a key factor in the development of sufficient knowledge, given that it limits how much knowledge can be gained within a given period; socialization towards sufficient knowledge itself is a process that occurs across time. In clinical settings, physicians must be able to elicit histories with enough pertinent information to establish a diagnosis within a brief appointment; likewise, in emergency situations, they may not have the time to address chronic concerns whenever more acute illnesses threaten the patient’s life. In the preclinical years, students also learn to carefully manage time, and accept the reality that they cannot know everything given that they did not have unlimited time to study.

In this section, I will describe how time—in these ways and in others—impacts the extent of what knowledge physicians can develop. In the same section I reveal how fourth year medical students in my study begin to contend with time limitations and bounding of knowledge within the clinic. I will then discuss how preclinical medical students’ training in the mock clinical course
(MCC) introduces medical students to the realities of limiting knowledge due to time restrictions. I will argue that time serves as a factor of sufficient knowledge because it imposes limitations around how much knowledge can be gained, and increases the pressure to prioritize the right types of knowledge for both medical learning and for patient care.

In the clinical years, fourth year medical students reflected that time played a significant role in their experiences of knowing and not knowing. They came to grapple with time limitations in daily clinical practice, and they did not always have the time needed to build a complete differential diagnosis or to fully study a patient case. I learned this when I asked the fourth year medical students in our interviews if they felt that they had enough time in their rotations to fully study each patient case they encountered on the wards. Without exception, the fourth year medical students told me that there was too little time, and too many dimensions of a case, for them to learn everything about each patient. In the following quotes from interviews, fourth year medical students make it clear that the limitation of time meant that they needed to prioritize some knowledge over others. The following interview quotes highlight the connection that students made between time, ignorance, and sufficient knowledge:

*Question: Did you feel like you had enough time to fully study the cases you encountered on the wards?*

“No. There was just too much shelf exam\(^2\) studying to do to allow me to study each patient to the depth that I wanted to. Especially in surgery, I tried to look into the anatomy as much as I could, but I was never satisfied with how much time I had to review it.” (Interview with Emily, fourth year medical student.)

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\(^2\) These are standardized written exams that students take for each of the specialties they rotate through in the third year.
“Not really. It’s like, it depends on the rotation. At least here, a lot of rotations require that you work on Saturdays, so you only have one day off a week. So you have to read and prepare cases for the next day. I just want to know the answers and not take my time.” (Interview with Heather, fourth year medical student.)

For Shi, a fourth year medical student preparing for residency in pediatrics, the limited time to study during the busy clinical years indicated that complete knowledge was not possible. To her, this was one reason why physicians sub-specialized as a way to narrow the scope of their knowledge to more quickly and effectively resolve cases, as we will further discuss later in this chapter. As Shi answered the same question as above:

“Not really! At least on clerkships, not so much, because we were so busy studying for shelf exams, and there are still lectures and other things to study for. In fourth year, it was better, because there were no exams and we just focused on becoming interns. This year, I could get a more thorough picture of what was going on, but I still found out that I couldn’t know every case in depth because I didn’t have infinite time. That’s why people sub-specialize! You only do what you really like. Otherwise it’s so overwhelming. Each disease could be studied to infinite detail.” (Interview with Shi, fourth year medical student.)

She continued:

“I’ve learned to prioritize the most acute problems, like the reason why the patient is hospitalized, or in the ICU, why are they here? And from there, I look at factors or things that are worsening or contributing to those problems, and other active things going on. When patients aren’t as sick, you can look at more chronic things. In the ICU, there’s just [no time] for that. That’s been an effective way to prioritize. Like this week, I had a cirrhosis patient, and they said, ‘don’t think about his liver problems, that’s not important right now,’ because he was intubated, and very sick. As a third year, you might not know what to screen out. As a fourth year, I’ve learned how to do that.” (Interview with Shi, fourth year medical student.)

In Shi’s mind, prioritization of knowledge was inevitable given the limited time she had to study each case in the clinical environment. Given this
restriction, she chose to focus on the more acute and potentially life-threatening conditions of her intensive care unit (ICU) patient, though in a less dire, outpatient clinical setting, she figured that she might focus instead on the longer-term management of chronic illnesses. Shi also observed that as a third year clinical student, she did not yet have the ability to sort information in this way, although as I will argue later in this section, preclinical students do learn to limit and frame their knowledge around time in the mock clinical course (MCC.) Other participants in my study similarly linked time, sufficient knowledge, and outpatient versus inpatient care settings. As one physician told me in our meeting:

“Contact with patients is time-limited, so there’s not a lot of time to be uncertain and we need to make clinical decisions fast. In the outpatient world, however, there is more time to resolve and explore the patient’s experience. With time, patient stories unfold outside of the context of diagnostic interviewing, and symptoms come into light within other social contexts.” (Interview with Dr. Smith, psychiatrist.)

It is important to note here that as a psychiatrist, Dr. Smith’s outpatient appointments tended to be longer and involved talk therapy. This certainly allowed her the time to develop more complete information on a patient, but other participants in my study found that other, non-psychiatric outpatient environments were indeed more challenging in terms of limiting information. Though Dr. Smith found that the outpatient setting afforded her more time to study and learn about her patients’ illnesses, Shi (fourth year medical student) at times found the opposite to be true:

“On inpatient rotations, you’re not as responsible for as many patients and you can manage [the studying]. In outpatient, you’re seeing more patients, so you have less time. But in any clinical setting, it’s hard to focus on studying because so much is going on around me. It’s hard to really study it, so you want to study at home, but then you’re tired!”
In both the inpatient and outpatient settings, however, all of my participants believed that they did not have enough time with patients or enough time to learn everything about the cases that they addressed in the clinic, regardless of how pressing a patient’s illness was. In addition to the direct effect of limited time on gathering enough information from patients, other participants observed that the growing patient load and therefore longer hours allowed for less time to keep abreast of developments in the ever-growing scientific literature. Dr. Jones, a physician faculty member at my field site, expressed this in our interview. She was particularly worried about the decreasing face-to-face time with patients alongside the simultaneous expansion of biomedical knowledge:

“There’s just an enormous amount, and you have to have the time to contemplate, to look things up, to keep that going. What I’m extremely worried about now is that there are so many patients, appointments are shorter, and it’s not good... you need that time, because there’s so much uncertainty. Then it [the biomedical knowledge] changes! ...you have to keep up on everything.” (Interview with Dr. Jones.)

For Dr. Jones, who practiced occupational and environment health, she repeated throughout our interview that it was crucial to have the time to record a complete history of a patient’s illness or injury given that she needed a full account to certify work compensation for injury or disability claims. She also needed time to review cases in relative detail when attempting to identify potential environmental hazards that a patient may have encountered at their work site. However, with very little time to address each of her patients, she needed to be more sparing about the questions she asked and the extent to which she “contemplated” their
histories. These epistemological and temporal demands further cut into the time
she felt was necessary to study recent biomedical advances. These problems
appeared to be a significant source of anxiety for her and for other physicians at
MWSOM.

In other instances, both fourth year medical students and physicians in my
study noted that there were differences in the relationship between time and the
kinds of knowledge that would be prioritized depending on the type of medical
practice in question. As I demonstrated above, Dr. Smith (the psychiatrist) and
Dr. Jones (the occupational and environmental health physician) both
experienced time constraints in practice that made their knowledge limited in
different ways unique to their specialty. Though we will discuss the specific role
of specialization later in this section, it is suffice to say here that different realms
of medical practice encounter different practical limitations that alter the
relationship between sufficient knowledge and time. Jiao, a fourth year medical
student who ultimately entered a neurosurgery residency, drew a distinction
between specialties in the way that time would impact knowledge and ignorance.
As Jiao explained to me:

“[Internal medicine] docs are more laid back, work up can take days and
they’re okay with that. Their patient isn’t going to die right now, so they
have the time to mull it out.” In surgery and critical care, though, she says
physicians need immediate answers, and you “can’t wait that long.”
Patients also tend to be more ill if they are receiving this type of care and
cannot wait for a physician to ponder about a myriad of causes of disease.
(Interview with Jiao, fourth year medical student.)

Other students made comparable remarks about the role that time would
play in regards to knowledge prioritization. Kyler (fourth year medical student)
and Anne (second year medical student) both expressed an interest in pursuing emergency medicine residencies. They each explained to me, in separate interviews, that emergency medicine physicians do not have the time to ponder what conditions a patient might have. Instead, emergency physicians must quickly apply procedural knowledge to stabilize the patient such that specialists could step in to take over extended care: for instance, an emergency physician would stop a traumatic arm injury from hemorrhaging, and then send the patient to a surgeon to repair the limb. Emergency physicians would not have time to gather complete information on a case due to any immediate threat to a patient’s life, and therefore would focus on instrumenting the knowledge they did need within a short time frame to stop any acute condition from worsening. To borrow Charlie’s (second year medical student) phrase, “you have to triage the knowledge,” in addition to triaging patients.

Time limitations in the clinical setting do not only impact physicians and medical students in my study. Across the United States, physicians are contending with the realities of decreasing time spent one-on-one with patients, and increasing time documenting whatever information they can gather in these brief appointments (Dugdale, Epstein, and Pantilat 1999). The latest MedScape Physician Compensation Report (Kane 2018) found that 56% of physicians in the United States spent an average of 16 minutes or less with their patients in appointments. An earlier report in the Annals of Internal Medicine (Sinsky et al. 2016) surveyed 57 physicians in a variety of specialties. The researchers discovered that physicians spent 27% of their workday with patients, and 49.2%
of their workday documenting patient information in electronic medical or health records (EMR/EHR.) Another study concurred that physicians spent more time entering data into the EMR/EHR system than they did face-to-face with patients, gathering histories, and performing exams (Young et al. 2018).

When I asked my dad—who practiced in a different city from the location of my field site—about the amount of time he had with his patients, he told me, “I feel rushed. We’ve become data entry specialists.” The experiences of my participants in the clinical setting therefore reflect a broader truth about contemporary medical practice, one that appears to be universal across biomedicine in the United States. With little time to interview patients and more time devoted to documenting visits, it becomes impossible to develop complete knowledge on every case. Therefore, it becomes necessary to omit questions, to ignore some aspects of a case, and to focus on the questions and the themes that—inevitably—are the ones that matter for the purposes of the electronic health record or for the specialty in which a physician comes to practice. Time plays a significant role in the bounding of sufficient knowledge, and is an important factor to consider when describing epistemological and agnotological processes in the clinic.

Though clinical practice presents distinctive constraints and responses around time and knowledge, medical students in the preclinical years are also confronted with time as one factor that shapes the knowledge they develop and the information they ignore. Most centrally, as I will describe in the subsequent paragraphs, preclinical medical students must learn how to study efficiently and
to schedule their discussions in the MCC carefully based on how much time they wish to allot to the concepts that they have prioritized for each session. Therefore, it is instructive to consider how preclinical training, time, and sufficient knowledge relate in order to uncover how students might be socialized to epistemologically operate within time constraints once they reach the clinical stage of their education.

I first identified time as a factor in sufficient knowledge when preclinical medical students throughout my observations made frequent comments like, “if I had infinite time, maybe I would know everything about this topic,” or “I didn’t have time to learn that, so I focused on other concepts.” Inevitably, I asked them: if you do not have unlimited time to learn unlimited things, what gets left out? What do you choose to overlook and ignore given that you aren’t able to know everything? As I explored in the previous chapter, students typically replied that they emphasized broader systemic knowledge over granular scientific mechanisms, that they spared discussion of debated theories in the biosciences, and that they sought to remember concepts and examples that would have wide applicability to their exams and future clinical practice.
But beyond what medical students prioritize and ignore, it is instructive to consider how they made choices around knowing and not knowing within the framework of time. One way that preclinical medical students learn to limit knowledge is through the creation of a daily session schedule for the MCC. This schedule, which is entirely designed by the students though it is assigned as a task by the faculty, indicates the ways that medical students first learn to ignore information, or the depth and breadth of information, depending on how much time will be allotted to discuss it.

First year medical students at MWSOM were especially sensitive to the limited time they had to discuss topics in the MCC. Their schedules (as illustrated
in the photo above) tended to be detailed and specific, to ensure that no
important topic was missed but no topic monopolized the amount of time they
had to learn about other, equally significant topics. Some subjects were deemed
easier, or less complex, and these received less time on the schedule. When
writing the schedule, both first and second year medical students consciously left
some concepts out, like extensive discussion of new drugs or drugs in the clinical
trial stage, unless this was warranted by the case. The dimensions of the case
that were deemed peripheral to the scientific processes and mechanisms
underlying the pathology in the case, such as ethics and epidemiology, were also
typically given less time and sometimes no time at all in the weekly discussions.
Students believed these topics to be important, and on some occasions they
were core themes of the assigned case worksheet, but they were not deemed
more important than learning the bioscience behind disease.

The schedule was one way for students to make choices about what
knowledge would be sufficient within the frame of time, however first year
students nevertheless felt concerned about using time to limit their learning
process. Many believed that the two-hour long MCC sessions, three times a
week, did not offer enough time to discuss all of the most relevant information
with their peers. They worried that they might miss knowledge that was
important, and struggled with what subjects to give time on the daily schedules.
The students were also concerned that if someone in their group was confused,
halting the conversation to explain a concept would take time away from subjects
that were also critical to their understanding. In these quotes from first year
medical students, the anxiety around these facets of knowledge, ignorance, and time are evident:

“I feel comfortable, but I don’t. MCC is only two hours long, and coming into medical school, there’s a lot to talk about in two hours.” (Interview with Sadiq, first year medical student.)

“If you don’t know, there’s probably someone who also doesn’t know... the downside is that if no one knows things, and they’re all different things, we run out of time [to answer all the questions.]” (Interview with Xian, first year medical student.)

First year medical students also used their framework of “high yield” concepts, as defined and presented in the previous chapter, to distribute time for different topics in their discussion. This typically occurred in the later units (unit 3 and unit 4) when medical students had a more concrete notion of what themes would appear on their exams and what content was the primary focus of USMLE Step 1 review books. They believed that it was imperative to devote time in class to explaining and sharing information on concepts that would be likely to be asked on exams. This sometimes meant cutting other subjects’ time short, or skipping a concept altogether if it was ultimately decided in the course of the session that it would not be tested. In the following classroom observation, students chose to eliminate an overview of medications salient to the case to focus on examining another aspect of pharmacology:

One student suggested that in the last fifteen minutes, students should not overview the types of drugs described, but to instead focus on “pharmacodynamics” because “I think that would be test-relevant.” Here the student uses his expectations about what could be on an exam to suggest what is the highest priority item for students to overview together, given that they do not have enough time in this session to review both pharmacodynamics and give descriptions of the characteristics of various drugs. (Observations in a first year MCC group, week of 4/10/2017.)
In a similar vein, the first year students learned by the end of the academic year to carefully police one another’s use of time depending on how informative they believed a discussion would be, or if they thought they could cut short a discussion that was deemed by fellow students to be non-important or unhelpful. Both the students who introduced concepts and the students leading the session became sensitive to the use of time in the MCC classroom, and were forthright about how that time would be allocated to various items on the schedule. The exchange between students in the MCC classroom, as I describe below, highlights these group decisions around time and sufficient knowledge:

“Do we have time to go through the entire cough mechanism?” One student asked. The student leader glanced at the schedule for today’s session, and said, “yes, if we do it quickly.” The student then approached the board, though another student interjected, “If we don’t have time, I have a great video that covers this that I can share with the group later.” The student leader suggested that the student would share the video for the group to view outside of class, though she still recommended that the first student go to the board. He drew a simple diagram of the lungs, marking where and how innervation controlled breathing. “The point is that you can cough, but it’s too weak to expel the mucous,” one student at the table summarized after the first student finished his diagram. “We have to move on, but that was really helpful. Thanks,” the student leader said, and moved the discussion on to address the use of nighttime ventilation for the patient in the case. (Observations with a first year MCC group, week of 4/2/2018.)

Here, it is clear that the preclinical students in the MCC had developed a keen awareness of time and the way time might influence the way they prioritized and limited knowledge. By the second year, medical students begin to streamline their MCC session schedules and curbed their discussions even more. Though they sometimes still encountered case worksheets that demanded the full two-hour session to discuss, they also began to work through cases more quickly as
they grew accustomed to the limitations that time placed around the depth and
scope of knowledge that they needed to prioritize in the group conversation. The
second year students noticed the shift in their own behavior, and reflected that
within the first year of medical school they had learned to become more sparing
with time and the concepts learned within time constraints. The facilitators also
did not intervene if the students finished their session early, tacitly endorsing the
students for being so exacting about the use of their MCC time. As I observed in
one second-year class:

The student leader asked, “what do the first year students do with all this
time?” as the students noticed that the first year students in the classroom
before them ran over time in their session. They then pointed out that the
first year students who occupied their classroom before them had written a
minute-by-minute schedule for each LO, including one highly specific
three minute period (8:20am-8:23am) for their second LO. One student
joked about how ridiculous this scheduling was, and another student
laughed, “we’re so much better at it now” and “we’re smarter!” Later in the
session, the students conclude at 11:10am, 50 minutes ahead of
schedule. They begin check out at this time, and the facilitator does not
comment that they should spend additional time or that the early finishing
time is an issue. (Observation notes with second year MCC group, week
of 9/18/2017.)

Beyond the MCC discussions, preclinical medical students also
encountered time constraints in their individual studying practices. The first year
medical students at the beginning of the academic year were overwhelmed by
the amount of information that they could learn on each of their weekly cases,
and they regularly studied for 8 to 10 hours a day while still feeling that they had
not fully learned the disease processes and physiological mechanisms that might
matter to each case worksheet narrative. As the students became accustomed to
writing session schedules and gaining a more innate sense of what scope of
information mattered—both from their exams as well as through lectures and textbooks—they also learned to place the same limitations on their study sessions outside of the classroom. This was especially apparent when I asked preclinical student interviews the question: *how do you know when you’ve studied enough for the MCC?* Students gave these replies:

“So I time block my schedule now, and I give MCC a specific amount of time, like three hour blocks, and what I can do in that block is what I can do in that block. I would get into one thing for so long that I’d reach my time, and I’d only [studied] a miniscule amount of the LOs.” (Imani, first year medical student.)

“I just set a time limit: like I’ll work on this case for 3 hours and the next case for 3 hours, so I don’t delve into things so much that my whole day is spent on MCC [studying].” (Interview with Rajesh, first year medical student.)

She feels that the MCC can be a “time dump,” and she tries to limit studying per case to 6 hours, while after this cap she will leave remaining questions for the group. (Notes from interview with Helen, second year medical student.)

While the students each had their own cap for the amount of time they needed to study, the fact that many of the students sought to limit time—as a means of consciously bounding information—illustrates the temporal factor of sufficient knowledge. That said, other medical students also set time limits for their weekly studying, but they still found it challenging to cut knowledge and to opt to ignore some information for the sake of time. Nonetheless, these students also recognized that by honing their time management techniques, they would become less inundated with knowledge and could abbreviate the scope of their studies. Consider these two instances where first year medical students comment on the role of cutting study and preparation time short:
During check out, one student said that she sometimes “reads everything about one LO for two hours, and then there is no time for the others,” and that she has begun to limit her studying. (Observation notes, week of 8/14/2017.)

“I run out of time [to study]! When I’m stressed enough to start, I start around Tuesday at 8pm, and at 12am or 1am I have a general comprehension and I can answer most questions, and then I go to sleep. If I manage my time more, I always spend way more time on MCC [than I need to.] The time crunch helps me not go into so much depth that it kills me. If I had unlimited time, I would do too much. Any time I have to talk to a patient I take too much time, too. It took me 30 minutes to get a history from a patient this week at the vision clinic, so I need to manage that better.” (Interview with Xen, first year medical student, on case worksheet studying and shadowing in the clinic.)

As these examples highlight, medical students in the preclinical years become highly conscious of the relationship between knowledge and time. They, like clinical fourth year students and physicians, accept that constraining time also constrains knowledge. Time thus becomes a factor of sufficient knowledge with applicability across all four years of undergraduate medical education and well into physicians’ years of practice. By considering the amount of time and the type of knowledge that must be gained within that frame, it becomes clear that some things can be known and others cannot. Without unlimited time, knowledge too becomes limited in the realities of medical training and daily clinical practice.

ACCESSIBILITY AND RESOURCES

The second set of factors that shapes sufficient knowledge are online accessibility to information and, by extension, material resources and infrastructure. With the ability to rapidly and easily search for symptoms, dosage requirements, and diagnostic criteria on the internet, both medical students and physicians do not need to commit large bodies of information to memory and can
prioritize study of the most crucial information while resorting to online databases in more uncommon or complex cases that are beyond the scope of their usual practice. As I will highlight through ethnographic data in this section, physicians and medical students alike can afford to be selective about what they know so long as they have access to additional information online, which can better inform situations for which they have limited understanding. I will also briefly consider how my participants believed that the resource of electronic medical or health records (EMRs and EHRs) limited the types of knowledge they needed in practice.

This truth of medical practice thereby slims the amount of knowledge that physicians must memorize, and allows them to deemphasize information that could be accessed later; further, the availability of the internet allows them to find information that they did not intentionally ignore, but that was beyond the usual scope of what they did know as specialists in distinct realms of practice. As I will observe in the end in this section, however, accessibility to knowledge online—as well as other forms of access to material resources of practice—differs widely across the developed and developing worlds. I will therefore clarify how resources at my field site might differ when compared to sites in other regions of the world. In sum, this section will begin with examples of accessibility of information in the clinical environment, and then move to a discussion of how medical students in the preclinical years respond to technology and resources in relation to their studies. The section will conclude with a discussion about how
material resources, more broadly construed, impacts knowledge practices and frames sufficient understanding.

The medical students and physicians in my study often noted that their ability to access information online meant that they could afford to ignore or overlook pieces of information that were not typically necessary for daily practice, while being able to locate and provide more particular knowledge when it was needed without having to commit it to memory. The most commonly cited online databases and websites that physicians and medical students in my study mentioned were UpToDate, MedScape, and DynaMed. These are peer-reviewed, online encyclopedias that provide summaries of current scientific knowledge and best treatment practices for a wide array of medical conditions.

As fourth year students especially noted, their physician teachers both used these databases and expected them to rely on them as well. In reflecting on their clinical training in years three and four, fourth year medical students gave the following anecdotes:

"Yes, I felt like I could look things up. Sometimes I would use the computers to go on UpToDate, or I Googled things and found things with .edu addresses. On rounds it would be sketchy to look on my phone [for information on the wards], so I would be hesitant to do that, since I didn’t want patients to think I was texting, but I would sneak peeks at my phone sometimes. The residents looked stuff up too." (Interview with Heather, 4/19/2018.)

"We have things like UpToDate to help us make decisions. You have to [look stuff up.] There’s too much information to keep all in your brain. There’s too many specific diseases and things that could go wrong... Residents will say, ‘if you don’t know the answer, look it up.’ And that was good. [Residents would] look up medications, or rare diseases. I saw it a lot more in outpatient than inpatient clinic, because you get more variety in the outpatient setting and so you don’t always know what’s going on.” (Interview with Emily, 4/9/2018.)
Heather and Emily’s accounts both note that the internet enables them to understand patient cases without knowing everything, and that they could miss certain details or dimensions of the case so long as they could quickly find information on these aspects when needed. As Emily keenly remarks, this tactic becomes especially useful in outpatient settings where—in her mind—physicians are confronted with a wider range of illnesses and injuries for which they might not always have a diagnosis or treatment at the top of their mind. Heather also followed her comment later in the interview with the observation that smartphones facilitate ignorance, to some degree, because answers to questions are always immediately accessible given the mobile nature of the device: therefore, physicians can forego knowing many things that are easily found online.

In other instances on the wards, physicians who required further information on a case would task a third or fourth year medical student to find the relevant data. This both allows the medical student to learn more about the case, and for the team to gather more information that they might not have previously had to contextualize what was happening with a patient. As fourth year medical student Jiao explained to me:

“Yeah, it’s expected that you look information up online. Sometimes [the residents and attendings] do it, but they expect you to go and look it up as a medical student for them. Like if something interesting comes up in a patient case, they might ask a student to look that up and do a presentation on it. Sometimes they [used] UpToDate, but they tend to want the students doing that” (Interview, 3/30/2018.)
Fourth year medical students learned that while they could access information online as trainees who did not yet have complete knowledge of the medical practices they observed in their clinical years, practicing physicians openly did the same. As Jiao and other peers indicated in interviews, attending physicians and residents did not hesitate to turn to their computer screens and smartphones when they were unsure of something. While all of the fourth year medical students in my study noted that attending physicians had the luxury of retreating to their office to find additional information on a disease, injury, or medication, they indicated that physicians did not intend to hide this behavior from their trainees or even patients. Residents would also use time in between cases to read textbooks and primary research articles in the residents’ lounge at the hospital, the medical students told me, but they too would search for information while on the wards and in interactions directly with patients.

The attending physicians and other faculty members I interviewed and spoke with at my field site similarly noted that accessibility of information online shaped the ways that they navigated knowledge and ignorance with patients. One physician, Dr. Brown, cautioned that, “some knowledge is not able to be looked up,” including appropriate ways to communicate information to patients and techniques for synthesizing medical knowledge in a multi-faceted patient case. That said, she stressed to me multiple times in our interview that physicians should “be honest [with your patients] and say you need time to find answers” (Interview, Dr. Brown, primary care physician and psychiatrist, 5/4/2017.) As long as a medical student developed the personal skills to engage
with patients, and the ability to critically assess complex cases, individual facts or more specific items of knowledge could be overlooked and located as necessary. Dr. Jones, another physician who practiced in occupational and environmental health, agreed. She added:

“Early on in my career I didn’t do as well as how I learned to do... I had a lot more anxiety about knowing all the answers, which of course no one can know all the answers. Over time, you improve and have less anxiety.” (Interview, 9/19/2017.)

Though both physicians noted that it was not always possible to find the right information online within the brief span of the appointment, it was important to turn to electronic resources that could provide information as soon as possible if the physician themselves did not have this knowledge. My own physician regularly logs in to UpToDate and other medical websites online to offer me specific treatment suggestions, look up exact dosage information, or check about drug interactions during our appointments. At my field site, one basic science professor encouraged medical students to seek out additional information when needed “via consultation, or through your iPhone by looking for answers online” (interview on 5/3/2017.) In sum, physicians in my study scarcely anticipated that they would know everything, and that committing to finding the answers and being truthful about the limitations of their own knowledge allowed them to be effective clinicians even without complete knowledge.

Preclinical students also realized that they could limit their knowledge and rely on access to internet databases to locate information that they might otherwise need to memorize on their own, or that would not be valuable to know for the majority of the cases they would encounter. As Hannah, a first year
medical student explained, information is “so accessible now” online that while
she would need a “base knowledge for practice,” she did not need to dwell on
obscure conditions or the exact dosage requirements for uncommon
medications. Hannah’s comment held true in conversations with other medical
students as well. As Nathan, a second year student and former biochemist,
confessed to me:

“I stopped going into scientific details, even as a biochemist, because I
love details. But I said, fuck it. Doctors don’t know everything. Even in the
clinic, physicians ask you to look things up. And I do fine. I ask good
questions. There’s so much information, and I’m only human.” (Interview,
6/9/2017.)

In the MCC classroom, first and second year students would often glance
at their computer screens to ensure that the models and charts they wrote on the
board were accurate, or search for additional information online regarding
challenging topics during the break in the middle of the session. Some students
were careful not to allow quick internet searches to become a crutch that
hindered their studying, but overall, students agreed that the internet was a
productive tool that enabled them to ignore information, given that they felt they
could find it when and if it was needed.

Preclinical students expressed with no hesitation that the internet played a
significant role in their decisions around ignorance, most typically about
specialized or granular knowledge that did not advance their overall
understanding of human health. In one classroom exchange, a second year
student praised her classmate for readily relying on the internet. “You are willing
to go straight to Google when we’re chasing our tail,” she said. Her peer
seconded, “knowledge is so accessible nowadays. If I don’t know something, I can find the information. If you [i.e. the patient] have something really specific, you can get that information when you need it.” A first year student in another classroom observation session commented, “If somebody asked me questions I couldn’t diagnose them [yet], but I could find the resources necessary to figure it out. I know the process, even if I don’t know the material, and dealing with the information is easier.” In an interview with a different first year student, Rajesh, he identified a similar sentiment:

“In the third and fourth year, [other medical] students have told me that they really only recall the information from Step 1 that relates to their specialty [of interest], and they forget all the rest because they don’t need it. Like the cardiology fellows will remember cardiology, or the pulmonologists will remember everything related to the lungs. And the residents will use the same resources like we do, like UpToDate, and over time, you can forget everything you learned for Step that doesn’t relate to your specialty. So the real purpose of learning all of this is learning how to learn, and learning major concepts, so you can [contextualize] your field against other fields of practice.” (Interview, 4/3/2018.)

For Rajesh, specialization (as I will explain in the next section) limits and narrows the body of knowledge that a physician might have, but access to information online means that physicians can afford to be highly specialized given that they can easily locate knowledge that is not typically crucial for a case when it becomes necessary. A fellow first year student, Yan, agreed that “the internet is always at our finger tips, so we can go look on UpToDate” when additional diagnostic information became critical to fully comprehend a patient’s case (Interview, 4/2/2018.) Two other students explained to me that accessibility of information made them feel that it was possible to thoughtfully limit what they had to learn:
“But there’s so much to know, so many drugs and bugs. How much do I really need to know, and how much can I Google as a doctor on the go? What will stay the same in 10 years? I can look up stuff that’s not emergent. Why do I need to have it in my head? It’s a waste of brain space and cognitive function and time. The acute stuff and the common things you need to have stored in your head, but that’s it, really” (Interview with Natalie, second year student.)

“I’ll ask, is this something I can memorize and remember in a year? If not, I can always look it up later. But if it’s something like comparing [two dermatological conditions], I can learn the drugs and get it [for practice.] I want broad knowledge that doesn’t go as deep. Sometimes when other students go into details I zone out, because it makes my mind-image of something busy and less clear. Like the dosing of drugs. When I’m a doctor I can look that up. And that comes from seeing what doctors I see practicing now remember, and what they look up.” (Interview with Amy, first year student.)

In both the clinical and preclinical contexts, it is instructive to note that while medical students and physicians did feel that access to information online allowed them to limit the amount of scientific and clinical knowledge they committed to memory, it required them to be literate and mindful consumers of information. Medical students and physicians could rely on the internet for answers, but they realized that they had to use reputable sources and that they needed to remain critical of the content and source of knowledge they found. As Dr. Brown explained in interview quotes that were presented earlier in this section, medical students need to develop strong data interpretation skills: in part because this enables them to mindfully assess resources in situations where they do not know. Further, medical students trusted databases like UpToDate because these were tools silently endorsed by the curriculum; students could freely access these programs through their university website, and they saw residents and physicians using them on the wards. Medical students also
commented frequently on cases—both real-life instances and those on the MCC worksheets—where patients shared information that they had found online to their physician. The students were sometimes critical of this practice, and often complained about patients’ reliance on less trustworthy sources like Wikipedia or WebMD. However, the medical students at MWSOM also understood that it was their responsibility to contextualize and make sense of this information with their patients, and to help them understand whether the resources they used online were reflective of their condition.

Implicit in the discussion about access to information online is an underlying conversation on material resources, which is important to consider when comparing knowledge and ignorance practices in developed versus developing countries. In the remaining paragraphs of this section, I would like to consider the role that material resources and access to technology play in sufficient knowledge in global biomedicine. In order to rapidly look up a disease online, a physician must have access to computers, internet, and—when they are busily moving between patient visits and meetings in the hospital—mobile technologies like laptops and smartphones. They must also have the supplies and the procedural technologies named on these sites to perform the corresponding treatments: if they do not have access to these materials, there would be little use in knowing them given that they would be impossible to utilize. Thus, physicians in resource-limited and developing settings may not be able to bound and curtail their knowledge like the medical students and physicians in my
study, who trained and practiced at a prominent university health center in the United States.

Though I do not seek to generalize all developing contexts, as resources and infrastructure may differ vastly depending on support from government health programs and non-governmental aid organizations, other anthropologists of biomedicine have noted that medical knowledge and practice can be markedly different in places with fewer material and technologies resources. As I remarked in the literature review chapter, many scholars have observed the ways in which physicians contend with limited resources in biomedical practice across the world (Finkler 2001, Brada 2011, Wendland 2010, 2012, Mckay 2012, Street 2011; 2014, Benton and Atshan 2016). Brada and Wendland’s works in particular demonstrate how medical students in resource-limited locations in Africa acknowledge the innovative and typically expensive treatments available to physicians in other nations, while focusing their knowledge and training more on how to creatively use the resources available to them to provide quality care to their patients. The students in Wendland’s study themselves had limited learning resources, meaning they, unlike students at MWSOM, could not always depend on a computer for quick access to information. Therefore, it is important to account for the possibility that physicians who do not have immediate or rapid access to knowledge online, or the materials to implement costly and cutting-edge treatments recommended by online resources, may not limit or ignore information in the same ways as physicians in developed countries.
However, even within the developed context of my field site, resources mattered. On numerous occasions, I observed fourth year medical students admonish preclinical students for suggesting the use of a treatment that, though potentially effective, would not typically be performed due to cost. Other students were quick to point out that they could know everything about new medications on the pharmaceutical market, but it would not matter (and thus could be ignored) if their patients could not afford them. Even my own physician commented that while the best measure of blood pressure resulted from the use of an ambulatory blood pressure monitor for 24 hours, insurance companies hesitated to pay for this diagnostic test and it was too costly to recommend to all patients with a family history of hypertension; therefore, my physician had to make due with the more limited knowledge of blood pressure readings performed in her office. Certainly the medical students in my study did not have to think as often or as seriously about sparing medical resources as their peers in other places across the world. That said, the material realities of the clinic placed restrictions on practice that made knowledge of more cost-effective and accessible therapies the highest priority.

As I have outlined here, access to information online and the material resources of medical practice shape what types and amount of knowledge that medical students and physicians are able to know and ignore. While it is true that the physicians and physicians-in-training depend on the internet to provide information that they might not typically need to effectively practice, this also requires them to develop a new body of skills on assessing appropriate and
reliable resources for medical knowledge. It is also important to note that material and electronic resources may not be available to physicians practicing in resource-limited settings, where they must learn to develop a different body of sufficient knowledge that is applicable to the types of treatments they can reasonably provide. To a different degree, resources can also impact sufficient knowledge in more resource-dense settings if they are practical limitations to implementing a costly procedure or therapy. In sum, the technological infrastructure around medical knowledge and practice is a key factor in the way that physicians and medical students alike come to distinguish what to know and what to ignore.

SPECIALIZATION AND GRANULARITY

In addition to time and accessibility of both information and resources, medical specialization also acts as a chief factor in the productive bounding of knowledge. Specialization in medicine is the trend towards dividing medical practice into a range of different types and forms of practice wherein a physician does not directly see or address all medical problems, but indeed, has a realm of expertise in a particular area (Weisz 2003, 2006). This area can be broad, such as primary care and internal medicine, or specific, such as cardiothoracic anesthesiology or orthopedic trauma. In either case, the practitioners generate different understandings of what information is important and necessary and what types of information can, or should, be overlooked. Often, the difference between specialties of practice is granularity: in other words, the level of detail and complexity of knowledge that a practitioner must develop as compared to
his, her, or their peers outside of that specialty. Here I will explore medical student and physicians’ beliefs about the relationship between specialization and sufficient knowledge, as well as describe how preclinical medical students’ training also indicates the role that specialization plays in the construction of knowledge and ignorance.

Medical students across all four years of training at MWSOM readily accepted that specialization was a form of limiting knowledge. Though there are many reasons why a medical student selects a specialty—from personal interest, to the work/life balance in that field, to their score on the USMLE Step 1 board exam, to the types of procedures and treatments they give—all the medical students I spoke with recognized that specialization would allow them to draw different boundaries around the knowledge they would need for that field. As Elle (first year medical student) explained, “It’s normal to have gaps in your knowledge, and you can go so deep into whatever topic, and thankfully it’s why we all specialize.” Many other students made similar comments, including:

“You can’t know everything. ‘Grad school is where you learn how stupid you are,’ and [the person who told me that] was a physician. He said that’s the most important thing to learn in medicine, that you just can’t know everything. I’ll be like, ‘I won’t go into cardiology, so I don’t need to know that.’” (Nathan, second year medical student.)

“It’s normal to have gaps in your knowledge, and you can go so deep into whatever topic, and thankfully it’s why we all specialize.” (Lia, second year medical student.)

“If I were a specialist, I would be definitely not be as upset about not knowing something outside of my realm of expertise.” (Zara, second year medical student.)
To the medical students in my study, specialization was a way to stake a claim to one body of knowledge that limited or changed the scope and depth of what they needed to know, rendering their knowledge more manageable and making their choice to remain ignorant in some areas of medicine professionally acceptable. In observations and interviews, medical students shared their thoughts on how specialties differed in their decisions around ignorance and prioritization of knowledge. Students made frequent observations around the limitations of knowledge by specialty. Note the following exchange:

“Oh yeah, like I know an emergency medicine doctor whose kid was sick, and his wife asked what was wrong, and he didn’t know. He said, ‘take him to the doctor,’ like the pediatrician,” one second year student told me. Another student echoed, “and yeah, like psychiatrists and surgeons, they do different things” (Observation notes, week of 4/2/2018.)

In interviews as well as observations, students made these distinctions even clearer. For example, primary care and internal medicine physicians, in their minds, focused on a broad array of conditions while being able to refer patients to sub-specialists when a condition required a specific intervention that was not a part of their practice. Psychiatry was limited in that it emphasized mental illness and distress quite specifically, but multiple students noted that psychiatrists were quick to consult with other physician specialists who might shed light on the bodily dimensions of disease that the psychiatrist might not fully understand in a patient assessment. The procedural specialties—such as surgery and emergency medicine—prioritized technical and skill-based knowledge of treatments, but tended to focus less on the long-term management of symptoms and psychosocial care that primary care physicians, internal
medicine physicians, and psychiatrists centered in their practice. Likewise, generalists (such as a pediatrician) would have a larger range of base-level knowledge, while sub-specialists (such as a pediatric oncologist) would have a deeper but more limited knowledge on a disease, patient population, or organ system.

Fourth year medical students who were applying to residency also commented that their choice of specialty reflected the kinds of information and concepts they wanted to focus on and the forms of knowledge they preferred to leave out of their professional careers. Jiao and Nikhil committed to residency programs in procedural specialties (neurosurgery and ophthalmology respectively) because they preferred surgical and technical knowledge to the “soft skills” (as Jiao put it) centralized in primary care fields. Kyler chose emergency medicine because it allowed him to see a wide variety of cases, while limiting the scope of this broad knowledge to the technical and procedural interventions needed for acute conditions. Emma (primary care) and Heather (psychiatry) chose their residency specialties given their interest in addressing patient needs in a more holistic way, and establishing ongoing relationships with patients as their primary providers. Though they both accepted that they might need to refer patients to specialists when necessary, having a wider base of biomedical knowledge would enable them to provide the widest array of initial help and insight to their patients.

The physicians I spoke with throughout my study expressed comparable thoughts on the relationship between specialization, knowledge, and ignorance,
and often discussed specialization in terms of what a physician ignored or did not know over what the specialist did know. This is why, in their minds, consultation (and teamwork, as we will discuss in the next session) was so critical between physicians who had distinct and unique realms of expertise, where each practitioner could productively focus their knowledge by ignoring the information that would be more relevant to another physician in that field. As Dr. Jones (occupational and environment health physician) explained, her practice was centered on verifying work-related injury and disability claims, and certifying the role of industrial chemicals and pollutants in a patient’s illness. This specialty required her to think broadly about the patient’s bodily functionality, work experience, and disability needs, but it nevertheless led her to focus much more on hazardous work environments than on other types of primary care concerns that patients sometimes expressed to her. A psychiatrist faculty member readily admitted that while she excelled in the area of psychotherapy, she had little experience in the area of forensic psychiatry and hesitated to serve as an expert physician witness in criminal cases when she was asked. She said she did not hesitate “to get a consultation for help from another specialty” when she felt it was warranted.

Another physician, who was trained and practiced in both primary care and psychiatry, recognized the need for sufficient knowledge. She noted, “too much knowledge is possible in patient care, but in residency the field of knowledge is narrowed.” To her, it was important to provide intelligible, concise descriptions of illness to her patients while balancing what types of information
she emphasized within her professional focus on psychosomatic distress. Thus, practicing attending physicians similarly recognized the role that specialization played in the limitations they drew around knowledge, both for themselves and for patients. All of the physicians in my interviews and in less structured conversations at my field site agreed that consultation served as an important way to bridge gaps in understanding between specialists as they reached out to peers who had a different realm of knowledge. This allowed them to consciously ignore the dimensions of medicine that they were not explicitly trained in, while nevertheless being able to connect patients to other physicians or receive expert insight on conditions for which they did not specialize.

Medical students and physicians alike were keen to point out when specialties differed in terms of knowledge and ignorance. Yet students were scarcely expected to develop their own, highly specialized knowledge in the preclinical years, and it was not until residency that they would begin to limit their knowledge by subfield. As a physician and professor of psychiatry at MWSOM noted, “students don’t and shouldn’t know about specialist knowledge. How could they know?” To her, the focus on a broad overview of human health and disease mattered most in the early years of training, and knowledge could become more specific and narrow as students gained additional training in their post-graduate intern year and subsequent residency.

While medical students did not need to become medical specialists in the early years of training, they certainly recognized that they and their peers might bring a kind of specialized knowledge into training depending on their individual
educational backgrounds, clinical shadowing experiences, and personal and professional interests. Students at MWSOM were encouraged by the faculty to pursue these more individualized specialist interests, and their academic schedule was intentionally limited from 8am-12pm with the expectation that they would have more unstructured study time for this purpose. In turn, this impacted their learning process and the kinds of information they sought out versus what they ignored or deemphasized. In observations, I noted on numerous occasions that students often filled specialist-like roles in the MCC, which revealed the types of information that they had a stronger focus on than their peers. In the following examples, preclinical medical students are consulted by their peers and, in turn, consult others for specialized knowledge:

One student asked another student, whom the group identified as the “pharmacology guy,” about why NSAID pain medications would be harmful to a patient with kidney disease. He said, “NSAIDs inhibit prostaglandins, and you need prostaglandin to dilate the blood vessels to get blood into the kidneys, especially if they are already damaged.” (Observation notes, week of 4/30/2018.)

“I find I rely more on my team to understand the physics, because we’ve been doing a lot of fluid dynamics and gas exchange lately. So sometimes they explain it in a way that the textbook didn’t so I can understand what’s happening, and they’ve done enough in-depth reading. But we were doing pharmacology, and talking about the different receptors, I was more comfortable with that because I had previous background in the lab, and I was the more vocal part in that discussion. I know when to rely on my group.” (Interview, Imani, first year medical student.)

“Our classmates have different backgrounds. One student knows biochemistry, math, and pharmacology, and he has had strong explanations in areas where I am uncertain. And in my unit 1 and 2 group, we had a student in the [dual-degree] bioethics program, so she had good insights. Even in first year, we have students who have interests in particular fields [like] osteoporosis and celiac disease, and they’ve done research in it and they know” (Interview with Brianna, first year medical student, on 4/24/2018.)
One student commented during check out, “There’s a big difference between the law and ethics, and people in medical school sometimes just group all the non-science stuff together and it isn’t the same.” Another student replied, “it shows that you’re passionate, and I like when you bring those interests to the discussions because we would have glossed over that stuff otherwise, and some groups probably did, but we didn’t.” (Observation notes, week of 2/12/2018.)

By providing specialist knowledge, individual students both asserted the types of knowledge they personally prioritized for their professional goals while applying these interests productively to analysis of the case. As I will explore in the next section, they also allowed other members of their groups to limit their own knowledge if they knew they could reach out to a peer with specialized knowledge on topics of focus beyond their own.

Medical students at MWSOM were both aware of the role of specialization in medical knowledge and ignorance, and conscious of the ways that they limited their own knowledge based on their unique background and professional interests in medicine. Both medical students and physicians noted that specialization, in many forms, narrowed the scope of knowledge a physician would need to practice in either depth (a niche subspecialty) or breadth (a broader primary care field.) The practice of consultation demonstrates that while physicians may learn to be consciously ignorant of information beyond their subfield, they nevertheless resort to seeking help from their peers to receive the necessary information. Consultation is echoed in the way that preclinical students learn to rely on fellow students with different realms of expertise in the medical school classroom. In the next and final section, we will explore this dimension
further by examining the role that teamwork plays in sufficient knowledge practices.

TEAMWORK

Specialization allows an individual to draw closer boundaries around the scope and depth of what must be known, but teamwork—the sharing of knowledge across a group of practitioners—is equally important when considering how medical students and physicians come to construct sufficient knowledge. As noted earlier, between medical specialists, consultation is one form of teamwork that allows physicians to bridge different realms of sufficient knowledge. In this section, I will further discuss how the transmission of knowledge between individuals with different specialties or areas of expertise allow individual practitioners to limit their own knowledge while developing a keen awareness about who else on their team might have the knowledge they do not. By fostering a sense of professional camaraderie and shared purpose, medical students and physicians alike are able to be sparing about what they individually know while mutually relying on one another—and other health care professionals—to bring other forms of knowledge that they might have consciously ignored or that were out of the scope of their practice and training into clinical interactions.

Students across all four years of training, as well as faculty members, stressed to me on many occasions that cooperation with other health care professionals was critical. In addition to consultations, support from non-physician clinicians was viewed as especially helpful when carving out individual
realms of expert knowledge. My participants recognized that fellow non-physician clinicians provided a unique array of knowledge and skills to the team. In particular, the medical students were especially grateful for the support of pharmacologists and pharmacists, who could supply information on medications and their physiological pathways that were sometimes too dense even for physicians. In the same spirit, they respected and valued the work of other clinicians who addressed aspects of care that physicians did not have the time or the appropriate training to handle. The following two excerpts from field notes demonstrate this:

The students began working through the equations for dosing pain medications. They expressed frustration and confusion about these equations, and worked together utilizing the board to write out and discuss the parts of each calculation. After about ten minutes of debate and conversation, the M4 facilitator stepped in. “On the wards, the pharmacy person will do the calculations for you,” she said. “That’s a five or six year degree,” one of the first year students added. (Observation notes, week of 4/16/2018.)

“And that’s why there’s PharmDs! They know about the drug interactions, and the burden of responsibility isn’t just on you. You have social workers and nurses, too. My facilitator always prefacing things with, ‘there are people to help you, like psychologists or psychiatrists, counselors and nurses, so they can help you.’ It’s important to not know everything, because the more you learn the more comfortable you get with not knowing and letting other people help you.” (Interview, Xian, first year medical student.)

Here, the medical students underscored the role of pharmacists on their clinical care teams. These clinicians could provide expertise in pharmacology such as dosing recommendations or descriptions of side effects that physicians might not know in full. Other professionals, such as nurses and social workers, provided care to patients in capacities that were beyond what physicians performed:
namely the day-to-day check-ins, feeding, monitoring, and discharge or relocation of patients to other facilities. Thus, physicians could only afford to overlook these dimensions of patient care because their colleagues in other clinical fields held roles that addressed these aspects of treatment.

One fourth-year medical student, Heather, further agreed that it was useful for different clinicians to have distinct areas of expertise and knowledge that allowed each member of the team to fill a different epistemological role. She clarified, though, that it remained important for clinicians to have enough of a common understanding of each case so that practitioners could operate effectively as a team:

“There are fifteen people on ICU rounds and only 3 of them are ever actually listening. So you have to have redundant information, because you don’t want to rely on others, or if they forget there can be a lot of problems. It’s definitely true that the nurse for the patient sees that person hour to hour, so they can tell you things a doctor couldn’t since they doctor only sees the patient once or twice in a day, and the pharmacist will know about specific drugs, which is helpful, and the medical student might know more than the resident if they only had one person to see that morning. The problem is just being able to share that information between people.” (Interview, 4/9/2018.)

The boundaries of knowledge across clinical team members mattered equally in clinical training and in the preclinical curriculum. Medical students in the preclinical years received dedicated training sessions on how to work effectively with clinicians in other fields of medicine as a way to prepare them for eventual practice. A physician faculty person at my field site led the development of an interprofessional (IPE) training program where medical students, dental students, nursing students, physician assistant (PA) students, and social work students joined together to discuss their differing responsibilities in biomedical
practice. The program’s tagline, “Health Care is a Team Sport,” indicates that medical professionals must cooperate together and bring unique skills and knowledge to the clinical space: a mission that was epitomized by the designs for a new medical school building which would house the university’s schools of nursing, dentistry, and medicine together to facilitate collaboration. The physician who founded the IPE program at MWSOM, a pathologist, expressed her personal fascination with anthropology to me on numerous occasions during my pilot research at the field site. It was no surprise that she, like an anthropologist, sought to create room for a common understanding across disparate cultures (here health professions trainees) at the university.

FIGURE 10: This graph indicates the growth in required IPE training at North American medical schools (AAMC 2016).

This conscious commitment to teamwork was evident in the ways in which students themselves acknowledged the necessity of relying on other
clinicians who could provide insights that would be considered out of scope for physicians. As I observed earlier in this section, medical students were aware that nurses and social workers, pharmacists and psychologists each brought their own expertise to the clinical team. Indeed, the medical students themselves served an important role that differed from the resident and attending physicians, given that they were able to spend more time thoroughly parsing the case and—like nurses—had more one-on-one time with patients to ensure that no significant detail of the cases went missing. Despite these efforts on the part of students and faculty to improve collaboration, though, teamwork sometimes faltered when clinicians were hesitant or unwilling to share knowledge in a collegial way. Before class one day, a group of first year medical students lamented this to one another in casual discussion:

Later today there is an IPE (interprofessional education) mandatory session, which is 2 hours long. During this time medical students have to meet with dental, nursing, public health, and social work students to discuss the boundaries between professions. Students have to write paragraphs about what they believe the other professions do, and the medical students noted that other health professions students are extremely critical of medical students. Having completed other such IPE sessions before, one medical student noted that a trainee from another program said doctors “don’t treat the person, only the disease” and that this individual felt IPE sessions are “stupid and not helpful.” (Observation notes, week of 4/2/2018.)

Here, the other clinical trainees in the IPE session derided the boundaries physicians placed around patient care by centering the disease and not the person as the object of treatment. This confounded the medical students, who later in the same conversation said that they were always the first to admit when they did not know something. When I inquired about IPE further, the students in
the group explained that they were happy to rely on fellow clinicians who could provide them with information that they otherwise would have overlooked. Therefore, while the medical students appreciated the role of other clinicians on the team, teamwork was not always a mechanism for limiting knowledge given that fellow trainees in other professions could be reticent about sharing the disparate knowledge that they focused on in a case.

As described in the previous chapter, the preclinical curriculum itself was designed to facilitate peer-based learning between medical students as well. In the mock clinical course (MCC), group dynamics and transmission of knowledge between individuals matter in the creation of sufficient knowledge. Faculty members who served key roles in the creation of this curriculum stressed to me on numerous occasions that teamwork played a significant role in helping medical students identify the boundaries of their knowledge and to know when to both share that knowledge and seek it out when needed. As one basic science faculty person, who helped design the third unit of the preclinical curriculum, explained:

“Well knowing is okay, it’s important that students start recognizing what you do know and don’t know. We try to work them through a process where students think about what the team is doing, and how they are doing—[asking] what I’m good at, what I’m not good at? This self awareness connects tightly to not knowing stuff” (Interview with a professor of molecular biology, 10/30/2017.)

In both observations and interviews, it was evident that preclinical medical students relied significantly on one another to learn concepts that they otherwise would have deemphasized, to fill in rifts in their knowledge that had been unclear during their individual studying, or to differentiate a student’s role on the team.
depending on what that student contributed that others could not. Overall, this meant that if a student failed to prioritize the right information, the team served as a kind of failsafe to ensure that they learned the most necessary concepts; alternatively, the students felt that as long as they could identify someone with knowledge they were missing, it mattered little if they personally remembered it unless it was critically important.

This form of teamwork mirrors the interactions between physician specialists, who may have different bodies of knowledge specific to their subfield, yet know when to consult with their peers who have greater experience in another subfield. As described in the examples on specialization, students with graduate training or scholarly interests in the biosciences could be consulted for relevant context on physiology and biochemistry, while students who had an interest in health disparities could provide social context that allowed other students who did not normally seek that information out to better understand it.

Like physicians who anticipated that they would have meaningful overlap in their knowledge with other clinicians, medical students in the preclinical years also believed that it was important to have a shared understanding of the material in their coursework: even when they accepted that they could consult with peers on an as-needed basis depending on the most noteworthy dimensions of each case. As the following exchange between students reveal, having the same general understanding of pathologies allowed them to ask more nuanced and complex questions about the material to peers who were equipped to help them:
During check out, one student commented, “I appreciate that in this group, I can come in and ask questions, and other people can talk about things that I didn’t find in my research. Everyone has something different to say.” Another student responded, “Yeah, and on that note, everyone comes to class with a basic understanding of the case. So when we do discuss things, we aren’t talking about simple questions. We can move to the next level, to work on stuff at a higher level of knowledge.” (Observation notes, week of 1/22/2018.)

When I described the teamwork factor of sufficient knowledge to a relative, who had recently retired from practice as a cardiothoracic anesthesiologist, he replied: “Exactly. You have to know enough pathology so that the one time every six months that you talk to the pathologist, you get what they are telling you.” Thus, as is the case in clinical practice, medical students agreed that the most useful way for knowledge to be shared amongst a team was for everyone involved to have a degree of knowledge on the same subjects, while individually being able to provide detail, context, and interpretation that other members of the team could not offer. In this way, medical students and physicians learned that while they nevertheless needed a strong understanding of the basic science underlying disease and health, they could limit their knowledge of other dimensions of a case as long as they could rely on fellow team members to explain them or otherwise transmit that knowledge to the group.

Through interprofessional and inter-specialist teamwork, medical students and physicians learn how to limit their own knowledge and seek out others who have knowledge that lays outside the boundaries of their own. This enables physicians and future physicians to limit their knowledge as a more complete picture of a patient’s case emerges at the intersections of multiple fields of practices: be they medical specialties or, as described here, at the crossroads of
multiple professions like nursing, social work, psychology, and pharmacology. Though there are practical hurdles to clinical teamwork and the transmission of knowledge between clinicians, it is evident that cross-professional communication and sharing of knowledge allows physicians to be more precise about the body of information they need to master and implement. The rise in interprofessional training at both my field site and at medical schools across the United States indicates that the role of teamwork is becoming increasingly and consciously recognized, and the trend towards interprofessional team practice carries implications for the types of knowledge and ignorance afforded to each clinical team member.

**SUMMARY**

In this chapter, I have presented an analysis of the four factors that I have observed as having an impact on sufficient knowledge development and socialization at Midwest School of Medicine, both amongst physicians and medical students. As I have argued, these trends are not exclusive to my field site, and the shift towards increasing physician specialization, limitations on time and access to resources in the clinic, and interprofessional teamwork all factor into contemporary medical education and practice in the United States. Given that these factors arise in early training and not just in the clinical training years or in clinical practice, we must consider how medical students in the preclinical years are oriented towards sufficient knowledge in ways that align with the conditions of future practice. I have demonstrated how the four factors are emergent in the medical school classroom, where preclinical medical students
confront the roles of time, teamwork, specialization, online information access, and resources in ways that align with the clinical environment and enable them to address and identify these factors early in their education. In the next chapter, I will discuss the implications of these findings—and those from Chapter 3—to multiple fields of scholarly and medical practice.
CHAPTER 5: Interdisciplinary Implications and Future Directions

INTRODUCTION

Though this dissertation primarily draws from methods and theories in the fields of medical anthropology and qualitative medical sociology, its findings may prove insightful within and beyond the social sciences. In this chapter, I will reflect on the ethnographic sections of this dissertation and posit how the concept of sufficient knowledge might be capitalized on in future research and in medical education. This chapter will begin by discussing the value of sufficient knowledge and future research trajectories of sufficient knowledge in three academic fields (anthropology of biomedicine, the related sociology of science, and agnotology) followed by two applied fields (biomedical ethics and medical education.) The chapter will demonstrate how the ethnographic study of ignorance can inform educational practice and scholarly work both within biomedicine and in other areas of professional practice and human experience. In total, this chapter will present the academic as well as the practical implications of sufficient knowledge across multiple disciplines.

IMPLICATIONS FOR THE ANTHROPOLOGY OF BIOMEDICINE AND THE SOCIOLOGY OF SCIENCE

In this section, I will expound upon the contributions that this dissertation makes to its disciplinary cores: the anthropology of biomedicine, and the sociology of science, scientific knowledge, and scientific ignorance. I will argue that the anthropological focus on knowledge, skill, and competence in biomedical practice is valuable, yet misses the centrality of ignorance and non-knowledge to
biomedical practice and training as I have described in Chapters 3 and 4. Further, I will suggest that a renewed focus on medical education in the scholarly literature might assist social scientists in locating ignorance, and the early socialization processes that sensitize medical students to the boundaries of clinical knowledge. In a related capacity, I will discuss how this dissertation expands work in the sociology of scientific knowledge (SSK) and its close relative, the sociology of scientific ignorance (SSI). Namely, this dissertation seeks to soften the divisions between ignorance and knowledge in science and to illustrate the co-productive nature of knowing and not knowing. In both parts of this section, I will outline how future research directions might advance the comparative and theoretical study of knowledge, ignorance, and sufficient knowledge.

Within medical anthropology and its sister literature in medical sociology, this dissertation restores the scholarly focus on non-knowledge present in earlier research (Fox 1957). As I observed in Chapter 1: Literature Review, anthropological and related sociological work on biomedicine has focused on themes of knowledge: competence, mastery, skill, and the relationship between knowledge and power. This is especially true of work on biomedical practice and ethnographies of physician training. However, as I have articulated throughout this dissertation, medical knowledge is to some degree predicated on intentional ignorance, and non-knowledge itself is an important and central theme in medical students' socialization towards eventual clinical practice. By overemphasizing knowledge in the medical profession, we risk mythologizing physicians and other
clinicians as more omnipotent than they truly are. To develop a more subtle and realistic picture of medical practice, we must ensure that our accounts of medical knowledge are accompanied by new literature on the ways in which non-knowledge and ignorance, in a variety of forms, influence biomedicine and the lives of its practitioners. This dissertation serves as one such account that seeks to highlight intentional ignorance, and its role in refining knowledge to render physicians-in-training more adept at resolving clinical dilemmas.

Moreover, the literature on medical education itself is quite limited, though it is beginning to undergo resurgence (Underman 2011, 2015; Jenkins 2018, Vinson 2018). Empirical studies of medical education in any capacity—be it on knowledge or ignorance, or on medical education in developed versus developing contexts—would expand the social scientific record and nuance portraits of the medical profession instead of casting it as hegemonic. The reemergence of research on medical education is thus not merely a call to expand topical knowledge in social scientific disciplines. By peering into biomedical training more deeply, and more often, anthropologists and sociologists might develop a more complex and varied understanding of what it means to train and practice as a physician today, and what value that knowledge and ignorance hold in medical practice.

Indeed, future work in the anthropology and sociology of medicine has ample space to advance the understanding of medical ignorance and sufficient knowledge. Through localized ethnographies, anthropologists could identify the variations in limitations placed on medical knowledge and ignorance at other
sites where the factors and environments around clinical practice differ from the one presented here. As I noted in Chapter 4, there are indications that medical education in resource-limited and developing settings present unique challenges to the types of clinical knowledge that is prioritized by physicians and other practitioners. Further research might also explore how other, related types of ignorance emerge across different clinical practice settings and in different clinical professions. For instance, one might ask: do nurses and midwives make the same types of choices around ignorance as physicians? Are there other forms of conscious ignorance that are practiced in non-scientific medical systems, and what is the epistemological and agnotological framework of these systems? In all, there is expansive room in the anthropological and sociological record to generate studies of ignorance and non-knowledge in medicine, even when these exist in relation to knowing.

This dissertation similarly engages with the sociology of science, spanning both the sociology of scientific knowledge (SSK) and the sociology of scientific ignorance (SSI) as detailed in Chapter 1. Sufficient knowledge unites these fields by demonstrating that knowledge is produced and given instrumental purpose by the winnowing that occurs when individuals choose to know some things while ignoring others. To my participants, the reality is that knowledge and ignorance cannot be studied separately if one is to understand how they experience the intellectual space between ignorance and knowledge. The very fact that the sociologies of knowledge and ignorance have their own, distinct names suggests that while we should map the exchanges between knowing and not knowing, the
two fields are somewhat distinct and knowledge and ignorance are separate concepts. It is also important to note that the newer and less developed field of the sociology of scientific ignorance (SSI) requires additional empirical research in order to cement the sociological understanding of how ignorance relates to knowledge within social groups.

The benefit of cultural anthropology to this scholarly dialogue is that, through the ethnographic method, anthropologists are able to gather experience-near data that highlights the messy, tangled, and complicated connections between knowing and not knowing in everyday life. Ethnography does not seek to make philosophical generalizations about the nature of knowledge or ignorance as distinct constructs, but instead to provide empirical evidence of how communities interface with information in their own, organic ways. However, having identified the phenomenon of sufficient knowledge within the context of my ethnographic field site, it is certainly possible—and indeed, quite crucial—that we consider the normative philosophical position of ignorance, as I will further discuss in the forthcoming section on biomedical ethics. Thus, future research on sufficient knowledge and other entanglements of knowledge and ignorance may benefit from both empirical, ethnographic study as well as theoretical and philosophical exploration.

As I have recounted here, both the medical social sciences and the social science of science, spanning SSK and SSI, have much to gain from ethnographic explorations of ignorance. In the fields of medical anthropology and sociology, the focus on ignorance and its co-productive relationship to knowledge
complicate the vision of medical professionals as knowing experts. Additional research in the topical area of medical education may further illustrate how physicians come to engage with both knowledge and ignorance as they enter clinical practice. In the sub-disciplines of SSK and SSI, this dissertation also encourages an expansion of studies of ignorance and of the complex exchanges that occur between knowing and not knowing. To avoid separating the two fields as distinct, researchers might one day turn to ethnographic methods to uncover the shared and entwined trajectories of epistemology and agnotology. In these ways, the framework of sufficient knowledge, and the application of ethnographic methods to studies of knowledge and non-knowledge, are instructive for research on biomedicine and other areas of scientific practice.

IMPLICATIONS FOR AGNOTOLOGY AND EPISTEMOLOGY

In relation to the field of science and technology studies (STS) and the sociology of scientific ignorance, this dissertation also seeks to expand the discourse on agnotology or the study of ignorance and non-knowledge. As I have outlined earlier, this recent and growing body of literature seeks to expand social scientific and philosophical understandings of the forms that non-knowledge can take and how ignorance, like knowledge, is socially and culturally constructed (Gross and McGoey 2015). In this section, I will outline the contribution of sufficient knowledge as a new framework for agnotology. I will especially underscore the role that ethnography might play as a method for developing new understandings of ignorance within epistemological communities. Throughout this section I will present how future research in agnotology and epistemology
might further explore the theme of sufficient knowledge and map the mutual relationships between knowledge and non-knowledge.

The principal contribution of this study to the field of agnotology or ignorance studies is a new, empirical example of the construction of ignorance through ethnography, which I have termed “sufficient knowledge.” Sufficient knowledge indicates that ignorance can be purposeful and intentional, and used as a means of limiting and narrowing knowledge such that the knowledge one employs is more manageable, precise, and relevant. In this way, sufficient knowledge highlights the significance of agnotology to its counterpart, epistemology. Ignorance and knowledge are symbiotic in sufficient knowledge: without conscious ignorance, as I have observed, physicians could not possibly operate given the enormous amount of biomedical knowledge that would be impossible to fully master. In order to practice, physicians are socialized and trained to establish both a depth and breadth of knowledge, and to consciously ignore information outside of that framework. They also learn both implicitly and explicitly that external factors such as time, specialization, teamwork, and accessibility of information and resources impacts the extent of what can be known and the types of knowledge that should be prioritized over others than can afford to be overlooked.

Though here I have identified sufficient knowledge as the prioritization and conscious omission of knowledge in the field of medical education, this principle is not exclusive to medical social sciences or the study of medicine more generally. Sufficient knowledge can be generated in any professional field or,
indeed, in any aspect of daily life. For example, engineers in a variety of fields—from civil to electrical to mechanical and biomedical engineering—might centralize and omit information quite differently from one another depending on the types of practical solutions they are generating. In studies of the family, it may be the case that grandparents intentionally overlook a parent’s rules for the child and instead prioritize their own notions of praise and punishment when the child is in their care. Thus, there are many opportunities for future scholars of agnotology to study sufficient knowledge within and beyond the contexts of medicine and health.

Because sufficient knowledge is relational—that is, it requires one to make choices about what to know and what to ignore—studying sufficient knowledge in a comparative fashion is crucial for the field of agnotology. In order to understand what factors influence the making of sufficient knowledge and how one selects what information to ignore, scholars must examine these choices at the local level within specific cultural and social contexts that shape decision-making and knowledge-making processes. This is where ethnographic methods have tremendous value to the interdisciplinary study of ignorance and non-knowledge. Ethnography allows researchers to gain experience-near data that can demonstrate the variety of human experience rather than render generalizations about human behavior.

In this way, ethnography may allow us to develop new understandings of the range of information that different social groups and communities choose to know or ignore, and how the specific context in which they live and operate
impacts these processes. The ethnographic analysis I have presented in Chapters 3 and 4 serve as one such example of how this method can illustrate the connections between constructions of knowledge and ignorance within a social community. Other studies of sufficient knowledge and agnotology more broadly should also apply ethnographic methods, especially as a way to widen the typologies we use to characterize different forms of ignorance and—further—to suggest that ignorance is more varied in nature than a mere void in knowledge. By examining the local contexts in which knowledge and ignorance are constructed, we might identify new theoretical categories in the philosophical space between knowing and not knowing.

As a field, agnotology or ignorance studies aims to demonstrate that ignorance can take numerous forms and that it is socially generated. Sufficient knowledge is one new classification of ignorance that also underscores the productive relationships between ignorance and knowledge, and demonstrates that agnotology as a field of study can make instructive contributions to the study of knowledge. Future research in agnotology may also apply the concept of sufficient knowledge beyond the context of biomedicine to explore the ways that conscious ignorance and the winnowing of knowledge emerges in other professional arenas or in aspects of daily life beyond the workplace and education. Lastly, through the application of ethnographic methods as this study demonstrates, agnotology can generate localized accounts of ignorance that consider the way specific factors shape knowing and not knowing within diverse communities.
IMPLICATIONS FOR BIOMEDICAL ETHICS

In this section, I will explore the applicability of the theme of sufficient knowledge within biomedical ethics (also called medical ethics or bioethics.) Namely, I will discuss how normative as well as descriptive or empirical ethics might promote new ways of understanding the ethical dilemmas and situations that may arise when physicians and clinicians choose not to know. I will consider mismatches between physician and patient knowledges, as well as how consultation and specialist teamwork might serve as a buffer against patient harm in cases where one clinician lacks total understanding of a patient’s illness. In whole, this section argues that sufficient knowledge as a mechanism for limiting and bounding information has practical implications for the way that clinicians respond appropriately and sensitively to patients’ needs. Bioethics as a field is uniquely situated to pose and respond to sufficient knowledge questions in biomedicine, and develop moral frameworks for addressing gaps in medical knowledge.

The construct of sufficient knowledge has implications for both normative and descriptive or empirical ethics: two distinct approaches that are both present in bioethical dialogue (Goldenberg 2005; Borry, Schotsmans, and Dierickx 2005). Normative medical ethics identify what should be done in a particular clinical situation, offering philosophical principles for moral action on the part of care providers. Descriptive ethics take an empirical approach and seek to understand people’s moral beliefs as they already exist in a particular community. While descriptive ethics tends to be more reflective of anthropological research than
normative ethics, both approaches stand to gain from the notion of sufficient knowledge in medical practice. In the coming paragraphs, I will discuss how sufficient knowledge advances scholarly conversation in both normative and descriptive biomedical ethics.

The notion that information can be (and indeed is) limited and prioritized into “sufficient knowledge” poses a series of questions for the development of normative ethics around clinician practice. If clinicians regardless of cultural and social context must actively curtail their own medical knowledge, given there is too much of it to master, then it is possible to make generalizable and guiding statements about what must be done in instances where clinicians have chosen to consciously overlook information. Normative ethicists might ask: is there a standard of ‘adequate’ knowledge that must be met by clinicians, and how does this measure differ both between physicians and across all health care professionals? How do we make decisions about what should always be prioritized and what should always be deemphasized, or is this impossible given the unique nature of individual medical cases? Do these expectations differ for patients versus physicians: in other words, should patients and physicians ideally emphasize and ignore the same types of health information and experiences to streamline and improve caregiving?

This dissertation does not seek to make definitive normative claims to how sufficient knowledge and intentional ignorance should be treated in medical practice. As I have demonstrated, different individuals and different specialties all have distinct priorities around what information they most need and want to
know; further, differences in knowledge between individual clinicians enables collaboration and specialization such that no one individual profession is unduly tasked with knowing all things in biomedicine. However, I do believe that if scholars accept that bounding and limiting medical knowledge by individual clinicians is inevitable given its vastness, we must then consider any universal expectations that we place on how physicians and clinicians should act given prioritized knowledge and strategic, selective ignorance. Ethical standards for sufficient knowledge developed by normative bioethicists may also offer clinicians a more explicit, accessible measure for prioritizing information, rather than simply anticipating that clinicians will selectively ignore the right types of information on their own.

There is equal space to consider the descriptive ethics of sufficient knowledge, particularly through ethnographic studies of medical education and practice akin to the one presented here. In future research, a descriptive bioethicist may ask: how might different clinical professionals be socialized towards different beliefs about prioritizing knowledge, and what implications do these beliefs have for the treatment of patients? What dilemmas might arise in different social contexts where sufficient knowledge practices produce distinct bodies of knowledge and ignorance? These questions would enable both bioethicists and medical social scientists to better understand the range of subjects that are left out of biomedical knowledge, and the types of situations where clinicians may miss key information within day-to-day patient care.
Descriptive bioethicists may also seek to pose the question of sufficient knowledge from the patient’s perspective in order to comprehend how a range of patient populations prioritize symptoms, side effects, or therapeutic options. They may ask: do patient populations concentrate on the same types of health experiences, and if not, how can patients’ own sufficient knowledges indicate the beliefs and values they hold around health? Here I reflect on Kleinman’s work (1982) that demonstrates the somatic rather than the psychological effects of mental distress are more heavily emphasized in Chinese society than in Euro-American cultures. Thus the treatment and knowledge of these bodily complaints would hold a higher priority for psychiatrists and primary care physicians who attend to some Chinese patient populations. By extension, a bioethicist might ask: how can we account for a variety of beliefs around prioritizing knowledge while ensuring that patients’ treatment is not compromised when a part of their illness experience falls through the rifts of what different practitioners think is “enough” knowledge on a condition?

There are, of course, very real consequences of medical ignorance and sufficient knowledge that both normative and descriptive bioethicists should grapple with. As I have noted in this section, selective ignorance may endanger the therapeutic relationship if symptoms which matter deeply to a patient are ignored by a physician or clinician who has preemptively removed those facets of illness experience from their consideration. At worst, a physician might consciously overlook part of a patient’s case that seriously threatens their health or life and becomes a problem of medical malpractice. In these cases,
bioethicists who can both identify local trends in clinician beliefs and practices around sufficient knowledge, as well as normative bioethicists who can formulate recommendations and standards for how to address these situations, are each needed to gain a full understanding of what sufficient knowledge means in practice and how it should be appropriately handled. Ideally, bioethicists would integrate both a normative and a descriptive perspective that would allow them to intercede in practical situations where sufficient knowledge may harm a patient.

The questions I have posed here indicate that there is ample ground for bioethicists to consider both the normative standards and the descriptive nature of the ethics of sufficient knowledge in biomedical practice. The instrumentalization of ignorance to consciously limit knowledge may create frictions in the patient-clinician relationship, as well as create gaps in knowledge of patients’ conditions that could negatively impact patient care and treatment. As I have explained in this section, the concept of sufficient knowledge and its emergence in medical practice would benefit from, and grow, with future scholarly discussion in the field of biomedical ethics. These discussions could explore the consequences of sufficient knowledge practices on the health and wellbeing of patients, and border seamlessly on the ethnographic investigation of local epistemological practices amongst clinical professionals.

IMPLICATIONS FOR MEDICAL EDUCATION AND EDUCATION RESEARCH

As I have argued throughout this dissertation, sufficient knowledge is the process of selectively and strategically knowing some things while ignoring others in order to develop a more refined, actionable body of knowledge for
practice. While scholars of medical education have long recognized that complete knowledge of biomedicine is not possible (H. S. Becker et al. 1976) and uncertainty is inevitable (Katz 1984) it may nevertheless seem controversial to claim that physicians knowingly limit medical information. Physicians are trained as medical experts, meaning it may be challenging to accept that ignorance is a central and common theme in the lives of medical students as well as practitioners. However, in this section, I would like to suggest that the phenomenon of sufficient knowledge—especially the dimension of purposeful ignorance—can in fact be instructive and meaningful to medical educators. By identifying what types of knowledge students omit, and why, and under what circumstances, medical educators may be able to better assist students in making decisions around knowledge and ignorance that are appropriate in a variety of clinical scenarios.

During my fieldwork, I experienced firsthand the anxiety that medical educators may feel at the suggestion that medical students are choosing to ignore some information while focusing on other forms of knowledge. At a conference in the midst of my fieldwork, I presented early findings on sufficient knowledge to an interdisciplinary audience of scholars, clinicians, and artists. Upon concluding my presentation, and returning to my seat through the crackle of applause, a woman in the crowd approached me. She introduced herself as a laboratory scientist who interfaced with physicians and trained medical students, and she found my talk to be very troubling. “You’re trying to argue that medical students should just ignore things and not know any of the science behind
medicine,” she exclaimed, “This is why medical malpractice is a problem! This is why doctors don’t know what they are doing! Because here are physicians thinking they can get away with knowing no science at all, thinking that all they need are overviews and basics and no details or theories.”

As I addressed in the section on biomedical ethics in this chapter, it is indeed true that intentional ignorance may lead to malpractice, or at the very least, the breakdown of the therapeutic relationship in instances where patients feel important aspects of their illnesses are being ignored. It is also true, as I indicated in the ethnographic analyses presented in Chapters 3 and 4, that undergraduate medical students do tend to deemphasize minute biological mechanisms and focus more on the systemic relationships between health, disease, and the body that give them a broader understanding of sickness and treatment. These are the results of sufficient knowledge that medical educators should indeed remain wary of. There may be instances in which faculty members and small group learning facilitators might wish to intervene more in guiding students towards the ethical problems underlying medical ignorance, as well as the granular scientific concepts that undergraduate medical students may miss in their generalist studies.

However, I also encourage medical educators to recognize the positive value in medical students’ abilities to focus and meta-classify knowledge based on the needs and contexts of particular medical situations. This process does not indicate that students are slacking in their studies. The phenomenon of sufficient knowledge suggests that medical students are being socialized to both learn
information and weigh its utility and importance for specific clinical situations. Students are also trained, implicitly and explicitly, to identify how factors like time, teamwork, specialization, and accessibility of information and medical resources might change what knowledge is “enough.” Here, selective and conscious ignorance is a sign that medical students are indeed making independent choices and critically thinking about the most effective and efficient ways to resolve patient cases. As faculty members step away to give students the space to make their own decisions about the material they are learning, they also offer medical students an opportunity to reflect on what knowledge matters and in what circumstances: rather than simply encouraging them to practice rote memorization of facts with less consideration for the implementation of knowledge.

In many regards, the process of sufficient knowledge is evidence that the student-led, small group learning formats adopted by many medical schools today (as I outlined in Chapter 3) are indeed having a positive impact. Problem-based learning programs like the one at Midwest School of Medicine (MWSOM) position students to make meta-level decisions around what information is necessary and useful and what information is peripheral or non-relevant for the purposes of a specific medical case. Students develop meta-knowledge about how and when to implement knowledge, not just the scientific knowledge itself. Further, as I have demonstrated in Chapters 3 and 4, medical students understand that information that may be neglected in one case might be central
to another depending on the symptoms and signs present for an array of patients.

If medical educators are concerned that medical students might not be making the correct decisions about what types of knowledge to focus on and what types of knowledge to omit in their studies, there are ways they might wish to intervene. A lecture or other instructional modality for teaching students about the concept of sufficient knowledge might help medical students understand faculty members’ and physicians’ expectations around the highest priority information. This might be organized in conjunction with a “curriculum for medical ignorance” as proposed by Witte and Kerwin (Witte, Kerwin, and Witte 1988; Witte M. H. et al. 2009; Kerwin 1993). Medical educators may similarly consider implementing reflective writing exercises that invite medical students to describe the types of information they tend to ignore, and to justify why this information seemed unnecessary or non-applicable.

The concept of sufficient knowledge may also be useful in reframing how medical educators measure and assess adequate knowledge amongst medical students. Rather than conceiving of a predetermined, established amount of information or specific types of information that medical students must know, medical educators may wish to ask: under what circumstances would this knowledge be adequate or inadequate? What contextual and social factors could change whether or not medical students’ knowledge is “enough”? And, of course: how might we change assessments or survey students to indicate what contexts would impact adequate knowledge of one body of information over another? In
sum, medical educators may wish to consider how to assess medical students' cumulative knowledge as dynamic and context-dependent rather than fixed and disconnected from situational and social influence.

Further, it is crucial that medical educators make it clear to students that complete medical knowledge is not possible: both because the scientific record is always growing and changing, and because no individual physician can know everything. Indeed, even basic science faculty members who encourage medical students to delve more deeply into their fields of study make implicit decisions around ignorance. A laboratory scientist might be in the field of biochemistry or molecular biology, genetics or pharmacology. Surely these fields overlap to a degree, but like medical specialists as I detail in Chapter 4, scientists each have a particular knowledge base within their individual field. And within that specialty, he, she, or they also likely studied a series of specific mechanisms, or cellular structures, which set his, her, or their work apart from other specialists and other scientists. By being forthcoming about the kinds of knowledge that both physicians and basic scientists opt to ignore by focusing their studies, knowledge, and practice on specialized dimensions of human health and disease, medical educators across the curriculum can help students overcome their own anxieties about the decisions they must make to limit and implement the scope of their knowledge.

I would like to add that research in medical anthropology, sociology, and medical education equally benefit by turning to sufficient knowledge and ignorance. Medical educators, medical social scientists, and patients alike share
the same expectation and hope that physicians know it all. In anthropology, we marvel at the importance of competence and mastery, knowledge and power in the profession of medicine: the same themes that no doubt capture the scholarly imagination of medical educators as well. Both of us speak at length about the consequences of this knowledge and who is able to wield it. Yet we do not consider that part of what constitutes physician practice is the ability to critically think, not always to critically know. As I have sought to demonstrate in this dissertation, physicians are socialized to instrumentalize ignorance thoughtfully in a way that renders knowledge usable in different contexts. They are able to bring information into focus when it matters most, under an array of practical conditions present in daily clinical practice. This practice can, and indeed should, be observed and documented collaboratively by both medical social scientists and medical educators across clinical training settings.

Beyond medical education, I argue that my work on sufficient knowledge has widespread utility for scholars of education, both those in anthropology and in neighboring disciplines. Sufficient knowledge provides a theoretical framework for studying and analyzing the mutual relationships between knowing and not knowing. This model can be applied in formal educational settings, such as the one where I completed my ethnographic research, or in other types of learning scenarios. These less structured venues span enculturation, socialization in the community and home, and self-learning through travel, independent reading, and childhood play. In all of these environments, individuals make choices about the scope and direction of their knowledge that entails decisions about what to know,
what not to know, and what knowledge is most essential, useful, or meaningful. Further, sufficient knowledge is not exclusive to professional training; as I observed earlier in this dissertation, even academic trainees must make choices about the scope of their understanding and demonstrate mastery despite not having absolute knowledge over their areas of focus. That said, fellow ethnographers and sociologists of professional training and practice may be among the first to identify how engineers, lawyers, skilled laborers, accountants, and many other non-medical workers learn to be strategically knowledgeable and meaningfully ignorant.

SUMMARY

In this chapter, I have outlined the contribution that sufficient knowledge makes to multiple disciplinary fields. I have presented both the implications of sufficient knowledge to each field as well as future research directions that each field might undertake to advance our understanding of the epistemological and practical nature of sufficient knowledge. This includes the academic fields of medical anthropology and sociology, the sociology of science, and agnotology, as well as the more applied fields of biomedical ethics and medical education. Throughout these sections, I argue that sufficient knowledge is a useful framework for the study of non-knowledge and ignorance in medicine as well as in professional, scientific, and other practices studied by social scientists. Given the growing interest in both qualitative studies of medical education and the limited current focus on non-knowledge in biomedicine and the sciences, sufficient knowledge may provide an instructive framework as scholars move to
investigate these topical themes in greater depth. This concept demonstrates the connectedness of knowing and not knowing as well as the utility of ignorance in refining scientific and medical knowledge. In bioethics and medical education, the phenomenon of sufficient knowledge may spur deeper conversation of the ethical and pedagogical dimensions of the limits that future physicians place around knowing and not knowing. Thus, I present sufficient knowledge both as an epistemological construct as well as an applied framework for monitoring and shaping knowledge that physicians and other clinicians should be mindful of in patient care. In all, this dissertation seeks to advance a case for the study of the relationships between knowledge and ignorance, and the space in which knowing is bolstered by the decisions to ignore, filter, and overlook some information over others, especially in medical learning and practice.
CONCLUSION

THINKING CRITICALLY ABOUT NOT KNOWING

On the last day of my observations with a group of second-year medical students, the students asked when my dissertation would be completed. “I hope to have it finished in a year,” I replied. “I want to read it!” a student exclaimed, and another followed, “Will I know which parts are about me? Wait...this is anonymous.” Before more colleagues could chime in, one pragmatic student inquired, “Yeah, but how long will this dissertation be?” I shrugged, saying, “I’m not sure, but dissertations in anthropology can sometimes reach around 250 to 500 pages.” “I’m not reading all of that!” One of the students laughed, “Can you write us, like... the Cliff Notes version?” Once the chuckling subsided, I joked, “Sure. But you do realize the irony in asking for an abbreviated version of a dissertation on having ‘enough’ knowledge, right?” The students applauded my retort, but asked again—this time in a more sincere tone—if I would, indeed, offer them a shorter version of my work on their experiences in medical school.

I end with this anecdote because it highlights medical students’ socialized response towards sufficient knowledge, which has tremendous impact on their own medical problem-solving skills as well as their outlook on knowledge and ignorance in a broader capacity. In particular, this ethnographic vignette encapsulates the epistemological phenomenon I have identified as sufficient knowledge. As I define it throughout this dissertation, sufficient knowledge is the process and the product of conscious and active decisions to ignore some information while centralizing other information. This process of sparing and
sorting knowledge allows individual medical practitioners to develop a more precise and necessary body of knowledge for contextual application. From a theoretical perspective, this process also demonstrates the fluid relationships between knowledge and ignorance, which rather than being separate and opposed, co-produce sufficient knowledge as learners and practitioners make choices about what to know and what to overlook. As I have articulated in Chapter 5, this premise has application both within biomedical practice and other venues of learning, work, and social life.

In this chapter, I will overview the arguments I have made in this dissertation, particularly in Chapters 3, 4, and 5. This chapter is intended to serve as a conclusion for scholarly readers in the medical social sciences and humanities, as well as a concise summary that my participants and medical educators may reference to familiarize themselves with sufficient knowledge and the instrumentalization of ignorance. Therefore, the chapter is written with minimal theoretical language from anthropology and agnotology so it is widely accessible to readers of all professional and academic backgrounds. In each of the following sections below, I will also consider and direct readers to the pertinent literature that I engage with and expound upon throughout this dissertation as initially discussed in Chapter 1: Literature Review.

Because the concept of sufficient knowledge was emergent and did not correspond to the original research questions and objectives designated in the study proposal, the sections below will be organized by the themes of the dissertation chapters and not by questions posed at the beginning of fieldwork.
Overall, I will remind readers how this ethnographic and anthropological dissertation advances interdisciplinary scholarship and educational programming in various fields, given the potential for sufficient knowledge as both an epistemological and a practical construct for medical training and clinical caregiving.

CONSTRUCTING SUFFICIENT KNOWLEDGE IN AMERICAN MEDICAL EDUCATION

In Chapter 3, I offered an account of how sufficient knowledge has arisen in the problem-based learning environment of contemporary American medical education. This spanned both a summary of recent changes to medical curricula across North America that facilitate boundaries around knowledge, as well as an ethnographic portrait of sufficient knowledge within the daily learning practices of my field site. As I demonstrated, both preclinical and clinical medical students across the first four years of medical training establish sufficient knowledge practices. They are challenged in many ways to limit, bound, and direct what they know such that they are properly addressing a specific patient case scenario; they learn to omit or overlook knowledge that is peripheral, and instead emphasize the types, depth, and scope of knowledge that would matter to a patient experiencing a certain disease or injury. As I will describe in the forthcoming paragraphs, preclinical (years 1 and 2) and clinical medical students (years 3 and 4) are both challenged through the curriculum to be thoughtful and directed about what they know and what they ignore.

As readers will find in the opening sections of Chapter 3, preclinical medical students at my field site are trained in a mock clinical course to limit
knowledge by studying case worksheets that list a learning goal for each patient, and to find information relevant to a case while deciding what information is non-necessary. Students begin to glean what “must” be known and what can or should be ignored through their mentors’ interjections, classroom learning objectives, as well as exams and beliefs about the expectations in future clinical practice. They employ the terms “high yield,” “low yield,” and “rabbit holes” to characterize the scope, depth, and breadth of necessary knowledge. Medical students explained to me that while some information is “high yield” (i.e. it will ‘yield’ better test scores or performance in the classroom and the clinic), other knowledge is “low yield” (non-important for the aforementioned contexts) and may become a “rabbit hole” (the time-intensive pursuit of obscure or granular information that is not directly applicable or informative.) In general, first year students at the beginning of their studies express anxiety and concern about limiting their knowledge, but by the end of first year and into second year they have developed the innate skills necessary to distinguish the most useful and valuable information from knowledge that can afford to be ignored.

Clinical medical students also learn that they cannot master all there is to know in biomedicine, and they too build sufficient knowledge practices in the new learning spaces of the hospital and outpatient clinic. As I highlighted in Chapter 3, pimping questions and case presentations were two venues where clinical students identified tensions in the boundaries of their knowledge and ignorance. Pimping is an instructional practice in which attending physicians or upper-level medical residents asking difficult and often highly esoteric questions of medical
students. As most medical students study to gain a comprehensive breadth of knowledge, they often feel that pimping questions unfairly require obscure knowledge that would not be widely applicable to clinical practice unless they were medical specialists. Case presentations also proved to be a central theme of clinical medical students’ navigation of sufficient knowledge, as they tried to decipher what knowledge to include in a presentation and what to exclude depending on the needs of their particular rotation and their health care team. Finally, the realities of daily practice—such as limited time with patients and chronic versus acute illness presentations—altered what information and how much information was prioritized for each patient.

In these ways, the curricular structure of American medical education socializes students against “knowing it all,” a concern that Becker and his colleagues were quick to identify in their classic study on medical training (1961). Instead, medical students today are tacitly socialized and sometimes directly instructed to make conscious and self-guided choices about what knowledge they need and what knowledge can be forgotten or set aside. Sufficient knowledge practices span both the preclinical and clinical years, and as I note in Chapter 4, extend well into physicians’ careers as medical practitioners. Thus, the undergraduate years of medical training—especially the preclinical years—are an important place to study the initial formulation of conscious ignorance techniques that students develop to refine and direct their knowledge before they enter formal medical practice.
STRUCTURING SUFFICIENT KNOWLEDGE: CONTEXTUAL FACTORS IN AMERICAN MEDICAL TRAINING AND PRACTICE

As I described in the opening paragraphs of Chapter 4, sufficient knowledge is not constructed within a philosophical vacuum outside of the influence of social and environmental factors. Within medical training as well as medical practice, there are many ways in which patient care and clinical learning create practical hurdles to absolute knowledge and thereby necessitate sufficient knowledge. I have pinpointed four factors that impact sufficient knowledge development within both medical training and practice: time, accessibility of information and resources, specialization and granularity, and teamwork. Below, I offer a summary of each factor and its effects on sufficient knowledge and ignorance:

(1) *Time* impacts sufficient knowledge by limiting the period in which someone is able to gather and implement information. Many medical students in my study expressed that if they had indefinite time, they could perhaps have more complete knowledge, but this was simply not possible. In fact, medical students in the preclinical years began to cut their study time as a way to artificially limit how much knowledge they gained; students who spent 6 to 10 hours studying often felt overwhelmed and paralyzed by the amount of information they had reviewed and they could not distinguish what concepts mattered most. Time also curtails knowledge and makes sufficient knowledge necessary in the clinical environment, especially as time with patients is in a decline and as medical emergencies do not allow a physician to
ponder a patient’s condition at length. This makes it imperative for physicians to gain and to utilize only the most necessary information.

(2) **Accessibility** of information and resources also influence sufficient knowledge. Namely, many of the medical students in my study—both preclinical and clinical—remarked that they did not feel the need to memorize some specific information like dosages and exact standards or illness criteria, given that these were easily referenced online at websites like UpToDate. Instead, students sought to cultivate a more broad and integrated knowledge of human health and disease in which they could situate more specific facts when needed. Physicians in my study similarly and regularly referred to online sources. Further, accessibility of resources can also have an effect on sufficient knowledge, as it would not be prudent to carefully study a procedure that is too expensive or inaccessible to reasonably perform. This is less of a hurdle for physicians and medical students practicing in developed countries than in resource-limited settings, however all medical practitioners must learn to practice within the framework of the material resources that are reasonably available to them.

(3) **Specialization** and granularity is another factor implicated in the development of sufficient knowledge. Medical specialists and sub-specialists learn a particular area of medicine in greater depth, at the cost of drawing a boundary around other types of medical knowledge that they choose to overlook. For instance, a cardiologist would focus
on heart conditions and allied systemic factors such as respiratory health, but deemphasize if not set aside knowledge on psychiatry. Thus, specialists and sub-specialists gain a more granular and specific body of knowledge by deepening their understanding of one area of medicine and not mastering others. Both students and physicians observed that general practitioners (such as family care physicians and internal medicine physicians) focused on broader systemic knowledge over specific scientific or procedural knowledge, but could refer patients for specialized care and consultation when needed. Students in the preclinical years also “specialize” in a way, as they each bring their own interests, professional backgrounds, and research experiences into their classroom discussions that renders their knowledge unique from other students, and which may lead them to limit or prioritize knowledge in different ways.

(4) Teamwork shapes sufficient knowledge by limiting the amount and types of information that any one individual clinician needs, while allowing knowledge to be transmitted between clinicians as it becomes necessary by others. Thus, individual medical ignorance can be somewhat ameliorated by communal knowledge across the healthcare professional team. This is echoed in the way that preclinical students in their small group learning venue can share knowledge between one another, and in the way that medical students are trained for interprofessional communication and teamwork in the clinical setting.
Consultation also allows specialists to defer to their colleagues, as both fourth year medical students and physicians in my study note. Therefore, medical students and physicians may not need to know information that a colleague can provide, so long as they have enough of a mutual understanding of the medical context that the knowledge being transmitted has meaning. However, there can be difficulties in the communal sharing of knowledge, if there is lack of rapport between health care professionals or knowledge that is lost in the busy daily activity of medical practice.

In addition to describing these factors of sufficient knowledge, I would also like to offer a few final comments based on Chapter 4. I argued in the chapter that the factors that alter and shape sufficient knowledge in medical practice are mirrored in the ways that medical students in the undergraduate years of training, even at the preclinical stage, contend with conscious and tactical ignorance. This means that research on medical socialization should seriously study the preclinical years as a site of professional growth, particularly in the specific ways that medical students learn to limit and frame their knowledge as well as their ignorance. Medical educators and biomedical ethicists should also weigh the role of these factors in how clinical cases might unfold, and formulate new ways to prepare medical students how to effectively navigate these factors as physicians. Perhaps most importantly, medical students and physicians themselves can learn from these factors, and reflect on how they impact their problem-solving abilities in the specific medical environments in which they practice.
In Chapter 5, I presented the implications of the construct of sufficient knowledge in anthropology, sociology, and ethics, as well as future directions for research on sufficient knowledge. I also discussed the applicability of my research in medical education, which in this chapter I have given its own, forthcoming section. In sum, this dissertation serves as a corrective to the expansive body of literature in medical anthropology and sociology on knowledge, mastery, and competence, which I outlined in Chapter 1. While these themes are no doubt important when studying the medical profession, they suggest that physicians are knowledgeable experts who do not contend with ignorance or gaps in their knowledge. The canonical medical social science literature has largely missed the centrality of ignorance and other forms of not knowing in medical learning and practice, with the exception of Renée Fox’s work on medical uncertainty.

My ethnographic exploration of sufficient knowledge aims to expand the discussion of ignorance in medical training and socialization, and to posit a new form of not knowing that complements Fox’s work. Sufficient knowledge is distinct from uncertainty: uncertainty refers to scientific ambiguity and an inability to enact knowledge that does not exist (either in science or the mind of the practitioner) while sufficient knowledge means the active, conscious decisions made about what to know and what not to know. While uncertainty is unintentional, ignorance in sufficient knowledge is intentional, and it is used to refine medical knowledge such that only high priority, impactful, and useful
information enters into focus. Sufficient knowledge thus illustrates the mutual production of knowledge and ignorance as ignorance is used to whittle away what information can afford to remain unknown.

In this way, this dissertation advocates for the inclusion of theoretical perspectives from agnotology (the interdisciplinary study of ignorance) in the social sciences and the adjacent medical humanities. Agnotology is centered on the notion that ignorance, like knowledge, is also socially constructed and made meaningful. Ignorance may also take a variety of forms and is not simply a rift or void in knowledge. In these pages, I posit sufficient knowledge as a new typology for the relationship between ignorance and knowledge that draws from McGoey’s concept of strategic ignorance (McGoey 2012a, 2012b). Strategic ignorance is a premise that states ignorance can be intentional and productive, though it was originally observed in drug companies’ attestation to a lack of scientific knowledge on the harmful effects of drugs to ensure that new pharmaceuticals would be approved for medical use. By drawing on theories like these, scholars of medicine can better understand how ignorance—rather than being solely an impediment to clinical knowledge—can be actively utilized in medical contexts.

In Chapter 5, I also outlined an argument for the role of biomedical ethics in the conversation on sufficient knowledge in physician practice. Chiefly, I argued that both empirical ethics and normative ethics shed light on the bioethical landscape of conscious medical ignorance. Empirical ethics is the study of the existing beliefs and values that already permeate a cultural or social group. This dissertation presents an empirical, ethnographic case of how medical
students and physicians come to make decisions around ignorance, and thus seeks to provide localized knowledge on how, where, and why physicians develop beliefs around sufficient knowledge. Normative ethics is the philosophical argumentation around what should be done given a particular set of clinical and patient circumstances. Though as an anthropologist it is not entirely in my purview to make claims about how physicians should properly limit and bound their knowledge, I suggest that normative ethicists have an important role to play in the creation of standards around ignorance and knowledge that could alleviate quandaries of ignorance and any resulting medical missteps.

Out of these sections, I present an agenda for future research on sufficient knowledge and related issues of ignorance in medical practice. I suggest that additional empirical work on sufficient knowledge in diverse global contexts is necessary (indeed, both from anthropologists and ethicists.) This research would determine other contextual factors that alter knowledge in different medical settings, and it could assess sufficient knowledge in other health professions such as dentistry, nursing, and social work. Sufficient knowledge is not exclusive to medicine, and anthropologists who work on other areas of human experience might also consider how conscious ignorance and the winnowing of knowledge emerges in their own field sites. In Chapter 5, I similarly argued that anthropology and sociology more generally should turn to the social construction of ignorance, given its relatively neglected position in the literature as compared to studies of knowledge. Future ethnographic and agnotological work (i.e. scholarly studies of ignorance) might widen the language and categories that scholars have to
describe varied forms of ignorance, and the symbiotic relationships between knowing and not knowing in social life.

SUFFICIENT KNOWLEDGE AS A CONCEPTUAL TOOL FOR MEDICAL EDUCATORS

To begin this section, I would like to offer a brief overview of what sufficient knowledge means for medical education, as I initially presented in Chapter 5. Before I embark on a discussion of the concept of sufficient knowledge itself, it is instructive here to pause and recount the way this ethnographic project was designed and how it enabled me to develop an account of sufficient knowledge in medical training. Ethnography is the practice of closely interacting and speaking with participants on a daily basis for an extended period of time in order to generate detailed descriptive data on people’s experiences. Using this technique, I spent fourteen months at a medical school in the American Midwest interviewing and observing first, second, and fourth year medical students as well as their faculty members, including scientists, physicians, and other non-physicians. The value of ethnography was that it allowed me to record themes in medical students’ day-to-day lives in training that were emergent, rather than tabulating pre-existing themes such as uncertainty or burnout through established survey instruments.

Through this method of close engagement with my participants, I was able to identify a new phenomenon that had not previously been noted in the social scientific literature or in current research on medical education. Medical students in my study would make frequent references to knowing “enough,” and use terms like “rabbit hole,” “low yield,” and “high yield” to refer to the amount and depth of
knowledge they felt was necessary, and to decipher what information was non-
necessary (see Chapter 3 for a full account of these terms in my sample.) As I
further describe in Chapter 3, problem-based learning models encourage medical
students to make these self-directed and calculated choices about knowledge,
though faculty members’ occasional interjections and their assigned learning
objectives ensured that medical students were not making entirely misguided
decisions about what to learn. As I discuss in Chapter 4 and as I summarize in
the sections above, there are also social and environmental factors in medical
training that alter what becomes “sufficient” knowledge that mirror physician
decision-making and knowledge processes in the clinical space. As I found,
these include time, teamwork, specialization, and accessibility of information and
resources.

The ultimate conclusion of this study is that medical students (and even
their physician mentors) make conscious choices about what not to know. By
doing so, they develop a more focused and applicable body of knowledge for the
patient cases in which that knowledge will be utilized. Thus, sufficient knowledge
is both a process of selecting what to know, and what not to know. I refer to the
latter as “conscious ignorance,” which unlike unintentional gaps in one’s
knowledge, are thoughtful and strategic in nature. For instance, medical
specialists choose not to know some information beyond the scope of their area
of practice. Medical students also make choices about what not to know
depending on the types of cases they are confronted with in training, and what
forms and depth of knowledge each case requires in order to be understood and
resolved. Most commonly, they make decisions to ignore information that does not advance the broader understanding of human health and disease that they need as undergraduate medical students, ostensibly saving more granular knowledge for future specialist training.

I would like to stress once more that I am not romanticizing ignorance in medical practice. As I note in Chapter 5, there are serious ethical ramifications to ignorance (conscious or unconscious) in medical practice, from failed communication between patients and physicians to medical malpractice and irreparable patient harm. It is critical for physicians to stay abreast of the scientific advances in their field of practice and to warn patients of the risks that certain therapies might carry, while also protecting them from iatrogenic harm to the best of their professional abilities. Moreover, patients trust their physicians to have answers, even if they are partial and imperfect, and this trust in knowledge between patients and their caregivers is deeply valued, most certainly in the American cultural context.

However, it is important to accept that absolute knowledge is an impossibility, and ignorance is an inevitability. Physicians cannot know it all. It is why physicians specialize, and draw careful boundaries around the realms of knowledge they will master and those that they will not. Given this premise, we may ask: is it better to be consciously ignorant, and to be aware of what knowledge is being left out, or is it better to be unconsciously ignorant and not make active decisions around what to know and what not to know? Certainly a physician and any practitioner or person can experience both forms of ignorance.
But as my data has revealed, medical school curricula are positioning and conditioning students to be primarily conscious rather than unconscious of what information they ignore. When medical educators position students to create learning objectives and to include specific information in case presentations, they are in fact asking them to make choices about what content will not be learned, and what knowledge will be omitted from their presentations of patients.

Though the term “ignorance” may elicit concern over the way medical students are trained, I encourage medical educators (both scientists and physicians as well as medical ethicists and humanists) to acknowledge the benefits as well as the consequences of conscious and strategic ignorance, and to adapt pedagogical strategies in consideration of sufficient knowledge socialization. As I recommended in Chapter 5, medical educators at all levels of physician training may wish to facilitate more direct conversations on the way medical students choose to write their learning objectives or case presentations, or to assign reflective writing exercises that ask medical students to justify the types of information they choose to ignore in a particular patient case. Educators (and medical education researchers) may also wish to assess adequate knowledge in a more holistic manner by examining not only what medical students do not know, but what they choose not to know, and under what circumstances. By being sensitive and aware of the fact that medical students and physicians are sometimes choosing to not know, educators can ensure that the directions conscious ignorance might take are productive and informed.

SUFFICIENT KNOWLEDGE AND THE UTILITY OF IGNORANCE
A concluding chapter is a final opportunity to thread together the strings of an argument, a discussion, or a story. While I have shared many of my own reflections on what I have discovered about sufficient knowledge and what I assert the importance of this construct might be, I believe it is important to give some of these parting words to my participants. The experiences they shared with me, after all, led to the redirection of this study from medical uncertainty and certainty to the unmasking of sufficient knowledge. Rajesh, a first year medical student, offered one depiction of sufficient knowledge that elegantly summarizes the way that medical students choose not to know. He tells us:

“When you come into medical school there’s a whole new way of understanding information. It’s the first time you have practical information that you’re supposed to use and apply. My uncertainty has really subsided, because I understand what information to look for and what information to know for a disease: the epidemiology, pathophysiology, signs and symptoms, how to diagnose, treat, and how a disease progresses. Within all that, you need to have an eye to the socio-political realm, which can manifest in the epidemiology but also the pathophysiology and definitely the prognosis. So now that I’ve created that map in my head what a disease is, I know how to go and find information. In some ways that limits what I am looking at, but it’s the most comprehensive thing that I can do. I think if you seek out all the information on a topic, you won’t form a narrative that flows.” (Interview, 8/21/2017)

As Rajesh’s words indicate, sufficient knowledge means developing the frameworks to sort through information based on its applicability and necessity to a given medical problem. This process allows a more clear “narrative” to emerge from the medical data and bioscientific context of disease for specific patient cases. Many types of knowledge enter into these choices, as Rajesh rightly comments, but all of them are assessed based on their ability to guide future
physicians to an actionable portrait of illness that positions them to resolve medical problems with greater efficiency and sense of clinical trajectory.

In this dissertation, I have drawn from perspectives across disciplines—such as sociology, science and technology studies, epistemology and agnotology, biomedical ethics, and medical education—to demonstrate the social construction of sufficient knowledge. Each disciplinary perspective emboldens the anthropological and ethnographic claim that ignorance itself can be the product of conscious choices made by individuals within the frame of their social environment. Sufficient knowledge allows medical students to act in the face of impossible mastery of all bioscientific knowledge, and makes their ignorance an active decision rather than a passive and unconscious barrier to understanding the suffering of their patients. While there are certainly ethical consequences that might arise from these decisions, and medical educators should be wary about how medical students are socialized towards ignorance, sufficient knowledge appears to be a thoughtful and sophisticated way for “experts” to act without becoming paralyzed by a lack of total knowledge. This observation indicates that greater attention across multiple disciplines should be paid to the productive nature of ignorance in medical and scientific settings: but most especially, this topic should be examined further in social science research, which has overwhelmingly focused on knowing over not knowing.

Though I believe these interdisciplinary perspectives are crucial to understanding the full scope of sufficient knowledge in biomedicine, I find that the dialogue always returns to my home discipline of anthropology and the
ethnographic method. Anthropologists seek to understand human behavior and the cultural and local contexts in which that behavior comes to be. We examine variations and patterns, exceptions and generalizations about human social life. Through this anthropological dissertation, I have identified the phenomenon of sufficient knowledge within the framework of medical education in the United States. While this institutional setting imposes its own limitations to the development of knowledge and ignorance that are unique to American medical practice—such as minimal time with patients and clinical specialization to name two such examples—other clinicians across the health professions or in other national and local contexts may also find the need to consciously limit what they know and what they ignore.

Further, as I have observed throughout this dissertation, sufficient knowledge is not only a construct applicable to medical anthropology or even to biomedicine. Though here I present a specific case wherein sufficient knowledge develops and is given social meaning, I hold that knowledge and ignorance are generalizable trends in human experience that should capture the ethnographic attention of anthropologists regardless of their topical or regional focus. In light of the impossibility of absolute individual and even communal knowledge, we must all make decisions about what to know and what not to know, in addition to navigating the ignorance we encounter unwittingly. It is how we give those choices meaning within the frameworks of our cultures and societies that matter, to both the advancement of social theory and to reflection on the position of ignorance in our own lives.
APPENDices

APPENDIX A: Analytical Codebook

The analytical codebook for this dissertation drew upon both *a priori* codes (on themes of uncertainty, knowing, and role performance) and *emergent* codes (on sufficient knowledge, meta-knowledge, and factors of sufficient knowledge.) Below is the definition of each code and the number of occurrences of each code that was identified in the qualitative data set. NVivo 11 software was used for the coding of this project. The codes are listed in ascending alphabetical order.

<table>
<thead>
<tr>
<th>NAME OF CODE</th>
<th>DEFINITION</th>
<th>NUMBER OF OCCURENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access – Online</td>
<td>Practices of rapid access to information online</td>
<td>40</td>
</tr>
<tr>
<td>Clinical Knowledge</td>
<td>Information on diagnosing and treating patients</td>
<td>243</td>
</tr>
<tr>
<td>Communicative Knowledge</td>
<td>Information on how to interact with patients and peers</td>
<td>163</td>
</tr>
<tr>
<td>Curricular Organization</td>
<td>Notes on design and structure of the curriculum at MWSOM</td>
<td>206</td>
</tr>
<tr>
<td>Interaction - Mentor to Student</td>
<td>Any key exchange between a mentor (facilitator, dean, faculty person, physician) and a student</td>
<td>404</td>
</tr>
<tr>
<td>Interaction - Student to Student</td>
<td>Any key exchange between medical students</td>
<td>416</td>
</tr>
<tr>
<td>Interpretation</td>
<td>Synthesizing or interpreting knowledge</td>
<td>148</td>
</tr>
<tr>
<td>Knowing - Meta</td>
<td>Instances of knowing what to know</td>
<td>102</td>
</tr>
<tr>
<td>Knowing - Primary</td>
<td>Instances of knowing the material</td>
<td>222</td>
</tr>
<tr>
<td>Learning Resources</td>
<td>Notes on the types of resources that students</td>
<td>281</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Code</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Not Knowing - Primary</td>
<td>Instances of not knowing something</td>
<td>456</td>
</tr>
<tr>
<td>Not Knowing - Meta</td>
<td>Instances of not knowing given gaps in the curriculum</td>
<td>112</td>
</tr>
<tr>
<td>Performance - Certainty</td>
<td>Indicating certainty to others</td>
<td>267</td>
</tr>
<tr>
<td>Performance - Uncertainty</td>
<td>Indicating uncertainty to others</td>
<td>118</td>
</tr>
<tr>
<td>Role Anxiety</td>
<td>Uncertainty over professional role or training</td>
<td>62</td>
</tr>
<tr>
<td>Specialization</td>
<td>Use of specialized and granular knowledge</td>
<td>110</td>
</tr>
<tr>
<td>Structural Knowledge</td>
<td>Information on the bureaucratic and political dimensions of medicine</td>
<td>42</td>
</tr>
<tr>
<td>Student Organization</td>
<td>Notes on how students developed study habits, learning objectives, and policies for classroom discussion</td>
<td>130</td>
</tr>
<tr>
<td>Sufficient Knowledge - Meta</td>
<td>Knowing what to ignore and what to know based on the needs of a case</td>
<td>471</td>
</tr>
<tr>
<td>Teamwork</td>
<td>Instances where teamwork impacted knowledge</td>
<td>48</td>
</tr>
<tr>
<td>Technical Knowledge</td>
<td>Information on the technical or skill-based aspects of medicine</td>
<td>72</td>
</tr>
<tr>
<td>Time</td>
<td>Impact of time on knowing and not knowing</td>
<td>202</td>
</tr>
</tbody>
</table>

**APPENDIX B: Semi-structured Interview Guides**

Below are the final versions of the semi-structured interview guides used for this study. The interview guides were written for the purposes of this research, and the questions were adapted as needed for individual participants.
Participants’ feedback was used to reword or refine any confusing questions, and to add new questions based on their experiences. These guides were complemented with any clarifying questions needed between the pre-written questions. Below, the guides include: Interview 1 and Interview 2 for first and second year medical students (M1s and M2s), Interview 1 and 2 for fourth year medical students (M4s), and the guide used for faculty interviews.

INTERVIEW 1: First and Second Year Medical Students

1.) Have you experienced any feelings of doubt, uncertainty, hesitance, or lack of knowledge during medical school?
2.) If so, what aspects of the curriculum or training make you feel this way?
3.) Do you believe your peers experience feelings of uncertainty?
4.) How do you and your peers communicate about these feelings, or do you prefer not to share these experiences with other students?
5.) Have you approached any professor, TA, or other mentor about these feelings?
6.) Can you describe an example of a time in medical school where you felt especially confident and certain? How did others respond to this?
7.) How would you feel if you came to the right answer, but it was through a means different than what your instructors or fellow students recommended?
8.) Do you believe experienced physicians ever feel uncertain? Under what conditions?
9.) What are your thoughts on the MCC Group format for learning? Do you think this format is helpful, not helpful, or has no effect on your learning?
10.) Do you feel comfortable sharing that you don’t know something in MCC Group?
11.) When you do know something, what are the best ways to communicate that to other members of MCC?
12.) What should someone NOT do when they are explaining a concept that they know to others?
13.) How would you respond if someone in the group were explaining something that you realize is incorrect or flawed?
14.) Is it ever helpful or productive to NOT know something in MCC group?
15.) Have your groups’ unofficial learning objectives (ULOs) ever not matched the official learning objectives? How do you reconcile these two sets of objectives?
16.) Do you believe it’s best if everyone uses the same resources for MCC, or better if everyone draws from different sources?
17.) How do you feel medical school differs, if at all, from your previous educational experiences?
18.) Are there any other experiences you’d like to share about your experiences in medical school thus far?

INTERVIEW 2: First and Second Year Medical Students

1.) Since our last meeting, have you continued to experience any feelings of doubt, uncertainty, hesitation, or lack of knowledge during medical training?
2.) If so, what aspects of the curriculum or training make you feel this way?
3.) How would you compare your level of doubt and confidence between the beginning of the academic year and now?
4.) Do you feel more knowledgeable or skillful than you did when we last talked?
5.) Are you more, less, or equally willing now to seek out the help of mentors (faculty, facilitators, or deans) than you were when we last talked?
6.) At this point in your training, how comfortable do you feel about having gaps in your knowledge?
7.) How, if at all, have your thoughts on MCC changed since we last talked?
8.) How have you learned to manage the large amount of information that relates to the weekly cases in MCC?
9.) How specific do you think objectives in MCC should be?
10.) To what extent do you rely on other members of MCC to learn new concepts or clarify your understanding of the material?
11.) How do you know when you’ve studied “enough” for MCC?
12.) Can you describe an example of a “rabbit hole”? How did you or your peers respond to rabbit holes in MCC?
13.) What does the term “high yield” mean to you? How do you determine what knowledge or resources will be “high yield”?
14.) Can you give an example of a “high yield” concept?
15.) Have you used the term “low yield” before? What is an example of a “low yield” concept?
16.) What are your expectations for second year?
17.) Are there any other experiences or comments you’d like to share?

INTERVIEW 1: Fourth Year Medical Students

1.) Have you ever experienced feelings of doubt, hesitance, or lack of knowledge during your medical training? Please describe these feelings.
2.) How would you compare your feelings of doubt and/or confidence between your pre-clerkship years and during clerkship?
3.) Before clerkship, how certain did you feel about your medical knowledge and skills?
4.) After clerkship, how certain did you feel about your medical knowledge and skills?
5.) During clerkship, did you find any new ways of acting as if you are certain, even if you are unsure of what you are doing or saying?

6.) Can you describe an instance during clerkship where you felt uncertain what to do or what was going on, but you tried to appear as if you knew what you were doing?

7.) Can you describe an instance during clerkship where you felt very certain about what you were doing? How did you mentors respond to this?

8.) Do your peers continue (if ever) to shape how you overcome or express feelings of doubt?

9.) Do you feel more or less comfortable sharing your feelings of doubt, hesitance, or lack of knowledge to your peers now than you have completed clerkship?

10.) Do you feel as comfortable now as you did before clerkship approaching your mentors with feelings of uncertainty or doubt?

11.) If you felt unsure about something, who would you seek out (if anyone) to address this uncertainty?

12.) How concerned were you during clerkship about appearing as if you were confident and knew what you were doing?

13.) What are your thoughts on the upcoming Match process?

14.) What are your expectations for the coming academic year?

15.) Are there any other experiences or comments you’d like to share?

INTERVIEW 2: Fourth Year Medical Students

1.) Did you feel like you knew enough information from years 1 and 2 to perform well in your rotations?

2.) Do you feel at this point like you know enough to perform well as an intern and future resident?

3.) Was there ever a time in clerkship when you didn’t know something, but were able to come up with an answer that was deemed suitable by a resident or attending?

4.) Was there ever a time during clerkship when a patient asked you a question that you didn’t have the answer to? How did you handle it?

5.) During clerkship, did you feel like you can look up something online during your shift if you don’t know the answer? What online sources did you use?

6.) During rotations, did your attendings or residents ever look up information online?

7.) During clerkship, did you feel that specialties differed in the way that physicians handled not knowing? How so?

8.) How important is it to have the answer to something if you know something else on your health care team (a nurse, physician, resident, PA, etc.) will also know it?

9.) During rotations, did you feel like you had enough time to fully study each case that you encountered?
10.) How did you make decisions about what information to prioritize for each case on the wards? Were there sometimes aspects of a case that you chose to overlook (due to time or other constraints)?

11.) Can you describe an example of a time during rotations whenever an aspect you thought was significant about a case proved to be insignificant or minor?

12.) What specialty (if any) do you plan to pursue?

13.) What are your expectations for the remainder of the academic year?

14.) Are there any other thoughts or experiences that you would like to share?

INTERVIEW: Faculty Members

1.) In your words, please describe how a physician should ideally approach a situation in which they feel uncertain: either of a diagnosis or a treatment.

2.) How should a physician appropriately convey uncertainty about something to a patient and to fellow clinicians?

3.) Do you believe that a physician can appear certain to a patient, even whenever the physician themself feels a great deal of uncertainty about how to progress with the patient’s treatment?

4.) Do you feel that the professional environment of medicine encourages practitioners to share their feelings of doubt, hesitance, or lack of knowledge? What mechanisms or outlets exist for health professionals to voice these concerns?

5.) Do you think that uncertainty is ever helpful or productive in medical practice? Please describe an example, if so.

6.) How do you guide or advise students whenever they approach you about feelings of doubt, hesitance, or lack of knowledge?

7.) Do you believe medical students feel comfortable voicing their uncertainty to faculty or other mentors and instructors?

8.) In your opinion, do you think problem-based and team-based learning methods help students become comfortable with “not knowing,” and voicing gaps in their knowledge to others?

9.) When you see that students are struggling to understand a concept or perform a task, at what point do you find it best to intervene?

10.) Do you worry that an answer or action appears “correct,” but that students are actually unsure of the concept or skill that they are demonstrating? How do you know when this is the case?

11.) How would you respond to a student who confidently gives an answer to a question, but that answer is incorrect or incomplete?

12.) In your experience, are there particular types of information or knowledge that are especially challenging for students to grasp?

13.) What is the most important lesson from the first two years of training that you hope medical students take into 3rd year and future clinical training?

14.) Are there any other thoughts or experiences that you would like to share?
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