Scott D. Stonington

Departments of Anthropology and Internal Medicine

University of Michigan (sdstony@umich.edu)

"Making Moves" in a Cardiac ICU: An Epistemology of Rhythm, Data Richness and Process Certainty

Medical Anthropology Quarterly

[rh]"Making Moves" in the CCU

[ab]Ethnographers of clinical rationality often assume that the goal of biomedical practice is to eliminate uncertainty to produce definitive diagnoses. In this ethnography of an academic cardiac intensive care unit (CCU) in the United States, bodies are conceived instead as ever-changing constellations of problems that make diagnostic certainty irrelevant and require clinicians to construct and reconstruct temporary models to facilitate action. They suspend their uncertainty to "convince themselves" enough to "make moves" on patients, driven by the relentless tempo of critical illness. This necessitates a practice-oriented model of professional rationality that can account for the flow of time, with implications beyond the biomedical. [epistemology, rhythm, rationality, hospital ethnography]

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/maq.12557.

[h1]Making Moves in the CCU

"Time to make a move," said Dr. Moroz, nervously.[1] "We've got a good story for heart failure … let's pick a tack and see how it goes." We were standing in a patient's room in the cardiac intensive care unit (CCU) of an academic hospital in Boston, Massachusetts, where I was completing my medical residency in the early 2010s. Dr. Moroz was the CCU fellow, whose role was to ensure that I made appropriate patient care decisions. During residency, I had been gathering ethnographic data for a study on medical decision-making, and Dr. Moroz's guidance provided an excellent view of it. Next to us, in a hospital bed, lay Mr. Rizzo,[2] an unconscious 72-year-old man in hemodynamic shock.

The room surrounding us was full of equipment displaying streams of data. There was a monitor with tracings from an arterial blood pressure catheter and continuous cardiac telemetry. There was a second monitor with tracings from a pulmonary "wedge" catheter—an intravenous line threaded through a vein in Mr. Rizzo's neck, down through the right side of his heart, "wedged" into the blood vessels of his lungs, measuring pressures on both sides of his heart. Next to us was a table with a large grid of additional parameters: ventilator settings, arterial blood gases, IV infusion rates, urine output rates. Our data-rich environment had temporarily precipitated what Dr. Moroz referred to as "a good story for heart failure." But that story might change soon, thus we needed to "pick a tack" and "make a move." These phrases, which seem glib, actually flagged an underlying existential terror, as we were acutely aware of Mr. Rizzo's place at the edge of a death that we were desperately trying to prevent.

Dr. Moroz's statements encapsulated a form of professional rationality that I had observed in the CCU. He was thinking narratively (putting together a "good story"), but not in the common sense of making meaning out events (Mattingly 1998). Instead, he was assembling temporary models of bodily physiology, precipitated out of clouds of data, required to facilitate action. A common

assumption in medical epistemology holds that the goal of biomedical practice is to place patients into stable disease categories that facilitate decision-making. Renée Fox's classic ethnographies of medical practice identified physicians' quest to diagnose stable disease entities and intervene to fix them, even if this knowledge was always incomplete, resulting in clinicians training to be constantly disappointed (Fox 1957). Or as Latour famously claimed, albeit in the very different context of lab research: "Science has two faces: one that knows and one that doesn't know yet" (Latour 1988, 7).

But in my academic medical residency in Boston, I had noticed that the physicians around me rarely cared much about what they *knew* about patients' bodies. Of course, we knew an enormous amount about disease models and practice algorithms, but we spent little of our time debating these and more of our time trying to choose our next steps. I rarely thought: "I know what is wrong with this patient." Instead, I almost always thought: "I know a good next thing to do." For colleagues who I interviewed, it was the same.

In this article, I ask a phenomenological question about expert rationality: What is in the mind of a clinician as she or he makes a therapeutic decision, particularly in the flow of (urgent) time? The answer is a portrait of a form of decision-making that may apply in a variety of settings, from Wall Street day traders, to air traffic control, to chess players.

A first step in modeling this rationality is to abandon terms that obscure time. One such culprit is the word "knowledge," which is often assumed to be what I term *phenomenologically viscous*—something held like a substance: moldable, craft-able, breakable, erode-able, owned by individuals, and slow to change. In contrast, Dr. Moroz's knowledge was rapid and always already temporary. There are many possible conceptual sources for making sense of this kind of knowing. One is science studies, ranging from Latour's illustration of the contingent, unstable, social process leading up to the collective decision that a representation is good enough to (at least temporarily) not question it further, a process he called "black-boxing" (Latour 1999); to Annemarie Mol's illustration of the work required to coordinate many objects (symptoms, imaging findings, lab results, treatment

responses) into a coherent disease category, in her case "atherosclerosis" (Mol 2002). One could also draw on pragmatic philosophy. John Dewey, for example, wrote about knowledge not as something acquired, but made in the flow of time: "Conceptions, systems of conceptions, ends-in-view and plans are constantly making and remaking, as fast as those already in use reveal their weaknesses, defects and positive values" (Dewey 1929, 133é–34). Or one could use practice theory. Elizabeth Cartwright, for example, in an ethnography of the use of electronic fetal heartrate monitoring in birthing decisions, argued that one can only describe medical practice by understanding the "logic of the moment," because "practice is irreversible and non-synchronous" (Cartwright 1998).

"It's time to make a move," said Dr. Moroz, and at one point when I hesitated, he added: "Remember: no move is also a move. It's time, let's do something." Our enemy was *inaction*—above all else, we needed to avoid paralysis, which would allow Mr. Rizzo to die.

As a tool for understanding the *experience* of this relationship to time, I draw on the concept of a "suspension" or a "pause" of uncertainty: a temporary choice to act despite the ongoing fact of not being sure. To explore this phenomenological moment, others have drawn on Samuel Coleridge's concept of "suspension of disbelief" (Coleridge 1985), originally meant to describe how readers temporarily overcome doubt about what they encounter in fiction. The concept has been repurposed by Molé Liston and Karlin to demonstrate how practicing professionals "provisionally ratify particular notions, ideas, subjects, creatures, and places and, in doing so, become capable of further engagement"[(Molé Liston et al. 2013)). The term "belief," like "knowledge," risks a kind of phenomenological viscosity, and religious studies scholars have sought to convert it into a verb of action just as science studies scholars have sought to do with knowledge (Favret-Saada 1977; Good 1994; Kirsch 2004; Lindquist and Coleman 2008; Needham 1972). But Coleridge's suspension of disbelief was meant to avoid this pitfall, to indicate a precarious, provisional détente, maintained through constant effort. When viewers watch a play, for example, they engage in a constant suspension; the slightest flaw in writing, directing, acting, or set design can precipitate them out of

this engagement. For Dr. Moroz, it was not disbelief that was being suspended, it was uncertainty about bodily processes. Dr. Moroz needed to build a convincing enough story at each moment of Mr. Rizzo's care to make a move, to not be paralyzed in the face of life and death.

Understanding this decision-making, with its relationship to time and action, to data and narrative, requires an ethnographic journey into the clinical space of the CCU, in this case in an urban American hospital in the mid-2010s. My goal in this portrait is to reveal an ideal type of expert rationality with implications for understanding expertise more broadly.

[h1]Rhythm and Process Certainty

Mr. Rizzo arrived in the CCU just after midnight. The intensities of the day had subsided: the edge of performativity for medical rounds, the flux of specialists, the timid appearance and disappearance of families who were made to feel like guests in doctors' territory rather than rightful occupants. By nightfall, the CCU developed an eerie calm, inhabited by the sounds of machines. Dr. Moroz and I had been passing the evening in a kind of terrified boredom, waiting for the energy to shift suddenly to a hurried rush to save lives. I had received Dr. Moroz's consent for my study and was taking occasional audio recordings of him whenever the conversation turned toward decision-making.

Around midnight, we received a call from the emergency department that they would be sending us Mr. Rizzo. We would later learn more about him as a person: that he was a beloved father and grandfather, a retired engineer who had become involved first in labor organizing and then in local politics. But when admitting him to the CCU, these details were omitted by the emergency department. Mr. Rizzo arrived to us instead as a bundle of quantitative data, the minimum that we needed to help us keep him alive.

Explaining these data requires a short detour into a pair of disease models that partly governed our decisions that night. Mr. Rizzo had had many recent admissions for heart failure. He had a weak heart, likely from a silent heart attack at some point in his past, now with irreversible damage

to his heart muscle. That evening, he had been brought by family to the emergency department with a fever and a cough, and then his blood pressure had dropped. He had been started on medications to stimulate his heart to increase his blood pressure ("pressors"). The challenge presented to the emergency physicians, and the reason for admitting Mr. Rizzo to the CCU, was to choose between two disease models to explain his low blood pressure: either poor heart function (heart failure) or infection (sepsis).

These models run as follows. On one hand, when the heart pumps poorly (heart failure), the kidneys do not receive enough blood flow to make enough urine, fluid accumulates, and the heart becomes overloaded, pumping less effectively. This causes a vicious cycle. In response, the blood vessels in the periphery of the body contract to help increase blood pressure. The treatment for this situation is to give diuretics to help a patient urinate the excess fluid.

On the other hand, if a patient's blood pressure is low because of a systemic infection (sepsis), the situation is opposite. In response to the infection, blood vessels in the periphery *dilate* abnormally, dropping the blood pressure. This low blood pressure is treated in the opposite way to a failing heart: by administering large quantities of intravenous fluid to "fill the tank" of the dilated blood vessels. One also simultaneously administers antibiotics to resolve the underlying infection.

Mr. Rizzo's body presented a diagnostic conundrum classic to CCU medicine: deciding between opposite mechanisms of low blood pressure. Since those mechanisms had opposite treatments, making the wrong choice could kill him. Moreover, his body presented a challenge one layer deeper, since he likely had *both* problems: He had a known weak heart, and his fever and cough were signs of systemic infection. The task was thus not to decide which of the two processes he had, but which was dominant.

A physical exam was one way of getting a sense of this: If Mr. Rizzo's peripheral blood vessels were clamped down, then he would be cool in the extremities; if they were dilated, then his

limbs would be warm and red. But like many patients in Mr. Rizzo's situation, his physical exam was difficult to interpret. On the phone passing off the patient, the emergency medicine physician described Mr. Rizzo's physical exam as "equivocal." She had thus made one more diagnostic decision before sending him up to the CCU. She had asked the hospital's interventional cardiologist to place a pulmonary artery (PA) catheter, an IV line inserted into a large neck vein, threaded down through the right side of the heart and wedged into the blood vessels in the lung, to measure pressures on both sides of the heart and use them to calculate fluid dynamics parameters.

For a time, PA catheters were very popular in CCUs. Then a study emerged showing that, despite providing a lot of information, they did not improve patient mortality (ESCAPE Investigators 2005). Yet this hospital had nonetheless placed a PA catheter in Mr. Rizzo. While waiting for Mr. Rizzo to arrive to us from the catheter lab, I asked Dr. Moroz why this was. "Many of us like PA catheters," he said,

> They're user-dependent, so some of us feel like we're better at reading them than the docs in the research studies. Basically, it's nice to have more data to work with when you're not sure what kind of shock you're dealing with. It helps move things along. It's hard sometimes to trust your physical exam alone.

In written form, this explanation sounds flippant, but in the context of the pending arrival of a patient spiraling into death, I could hear an edge of fear in Dr. Moroz's voice. For him, having more data meant that he could trust his decisions more, which would prevent falling into a paralysis that would certainly end in Mr. Rizzo's death.

Dr. Moroz claimed that the device was "user-dependent." This dependence is based on the fact that PA catheters have to be advanced into and wedged in the pulmonary artery, creating a seal so that the pressure on the two sides of the catheter can be measured. But it is unclear when this wedge has occurred successfully. Deciding if one is in the right place requires a qualitative determination

based on the shape of the pressure waves on the catheter monitor. The pressure numbers are then fed into two different equations, each based on a different set of assumptions about human physiology. Errors in the input numbers get amplified in the output, as do any mismatches between patient physiology and the physiology assumed by the equations. As a result, the two equations often produce contradicting portraits of the patient's condition. And these, in turn, may contradict what is seen on physical exam. The result is a cloud of data, full of shades of grey, which requires interpretation.

Dr. Moroz explained:

> Usually, between the three pieces of data [physical exam plus two different quantitative PA outputs], you can convince yourself of a tie-breaker. You have to decide something, because no decision is also a decision. Eventually, the patient's physiology will declare itself and you'll figure it out. But now, you have to pick a course.

"It will declare itself …?" I prompted.

At this point, Mr. Rizzo hadn't yet arrived at the unit, and we had time for some fieldwork, so Dr. Moroz humored me, though we were both talking nervously and quickly. He explained: "The problem will either get better, and we'll assume in retrospect that we got it right. Or it'll get worse, and we'll switch tacks, and then we'll wait and see again."

Then Mr. Rizzo arrived, connected to monitors, catheters, cuffs, IVs, and an endotracheal tube with a mechanical ventilator. As soon as he arrived, we grabbed his body, and Dr. Moroz called out to him that we were there to try to save his life. This touchstone to his physical body also doubled as our first piece of data: His skin was neither clearly hot nor cold, providing no clues about his physiology. We were then thrust into streams of data from the various instruments attached to his body. As these data arrived at us, we were aware of standing in the midst of an (irreversible) flow of time.

There are many possible resources for making sense of time, ranging from the analytic philosophy of the nature of time itself (Heidegger 2008; McTaggart 1908), to the relationship between social forms and the rhythms of daily living (Bourdieu 1972; Certeau 2011; Dewey 1929; Lefebvre 2004). But for clarity, I draw on two terms from music (Klemp et al. 2008) and practice theory (Bourdieu 1972; Cartwright 1998). The first is *tempo*, the subjective speed of time's flow. The second is *rhythm*, the sequential and related timing of events within that flow. A piece of music can be played with a slow or fast tempo without changing the rhythmic relationship between notes.

As soon as Mr. Rizzo arrived, time's tempo in the room accelerated, determined by Mr. Rizzo's place at the edge of death and by our need to act to stave off that death. And in the midst of this tempo, there were rhythms all around us. There were physiologic processes within Mr. Rizzo's body: largely inscrutable, winding him toward destruction. There were data, some continuous like his pulse oximeter giving second-by-second readings of arterial oxygen concentrations, and others periodic, like his blood pressure cuff firing automatically, filling, measuring, and then reporting a result every 15 minutes on a screen. There was the frequency with which Mr. Rizzo's nurse or Dr. Moroz or I activated the PA catheter and then made a reading or performed parts of the physical exam.

The moves that we made occurred in rhythm, with times-of-effect and durations-of-action. If we chose to give diuretics to help offload Mr. Rizzo's body of fluid, there would be an interval from ordering the medication to giving the medication, and then an immediate effect (offloading the lungs of fluid), followed by a slower effect (removing fluid from the circulatory system significantly in the first hour, then decreasingly over six hours). And so every moment standing by Mr. Rizzo's bedside was different from the prior moment and from the imagined next moment: a combination of bodily changes, streams of data, and interventions.

Because of this flow of time, Dr. Moroz was not engaged in a process of trying to diagnose definitively what was going on in Mr. Rizzo's body. The PA catheter's ability to provide knowledge,

to provide a window into some imagined truth, was already a matter of history. But the device was still useful. This was because it helped us "convince ourselves one way or another" so that we could "make a move." We were engaged in *suspending* uncertainty rather than doing away with it, using the instrument to help us temporarily set aside just enough of our doubt about what to do next, to launch ourselves out of paralysis and into action.

For John Dewey, learning was not the acquisition of knowledge but something that one *does* (Dewey 1929). Nate Klemp likened Dewey's take on this process to jazz, where actors in situations must "organize activities in time, at a particular time, often at just the right time, and always with a simultaneous concern for both the future and the past" (Klemp et al. 2008). For Klemp, "art, education, ethics, and logic—topics all too easy to treat statically—are ongoing temporal achievements," for which "movement, direction and rhythm are essential resources for anyone figuring out what to do next" (pp. 4–5). For jazz musicians, a piece of information in the present moment (such as a surprising or mistakenly played note) must be carried forward and rewritten into a new context as new information comes to light. A jazz musician can play later notes to make earlier notes make more sense. In the same way, Dr. Moroz explained that "the problem will either get better, and we'll *assume in retrospect* that we got it right. Or it will get worse, and we'll switch tacks, and then we'll wait and see again." Just as the only thing a musician cannot do is stop, for Dr. Moroz, no decision was a decision to let Mr. Rizzo die. The flow of time, with its inevitable path toward death, was the ultimate taskmaster.

This is not to say that we lacked certainty. In fact, the result of suspending uncertainty about Mr. Rizzo's physiology, even if it was not knowing what was wrong with him, was what might be called *process certainty*: getting ourselves to confidence about a *good next thing to do*. As one of my professors, Dr. Ackermann, explained in a video-recorded case discussion about a complicated CCU patient:

In medicine, you never really know anything. All you need is: (1) a plausible diagnosis; and (2) a logical plan for the next step, whether diagnostic or therapeutic. Then, you pick a time frame to reevaluate, and repeat steps (1) and (2). Are you ever "right?" Not exactly. But the patient gets better, and then you move on.

This process, an ongoing reevaluation and suspension of uncertainty, moves things forward. Whatever certainty we experienced was made, not had. As soon as we had made it, we acted. And then the always already changing situation forced us to embark again on the process of making just enough certainty to make the next move.

[h1]How to Suspend Uncertainty: Data Richness and Rhythm

If Latour famously claimed that "science has two faces: one that knows and one that doesn't know yet" (Latour 1988, 7), we might add that, during our night in the CCU, a third face emerged: one that would never know, that did not in fact aim to know, but aimed instead to *act*. Annemarie Mol has provided tools for thinking about this "shift from asking how sciences represent to asking how they intervene" (Mol 2002), by treating representation as part of practice. In her study of the nature of atherosclerosis in a Dutch hospital, Mol illustrated the processes by which different objects (patient symptoms, ultrasound images, blood pressure measurements, tissue samples under a microscope) were made to assemble into a coherent disease category. In situations when objects seemed to clash—e.g., when symptoms and ultrasound findings provided contradictory representations—the drive to treat often determined which representation prevailed. Mol strategically chose atherosclerosis for her study because it was a stable and unquestioned disease entity, so she could illustrate how even seemingly closed representational categories require constant coordination in practice.

Our night in the CCU involved a form of decision-making even more skewed from representation toward action. Mr. Rizzo's dying body was changing so quickly that our goal could not be to maintain a coherent portrait of his disease process. A first entrée into this difference is to explore

how the CCU (of that night) compares to other sites within the hospital. To begin with, one might say that many other places within clinical practice function in a Latourian fashion, with what he called a quest to "black-box" representations (Latour 1988), in this case used out of Latour's original context of lab sciences, converted instead to clinical practice, where a diagnosis itself might be considered a type of black box linked to an individual patient (Sanz 2016). During my time rotating on oncology wards, for example, oncologists would repeat a pedagogical refrain to one another that "tissue is the issue," meaning that all practice decisions hinge on obtaining a tissue sample to send to the pathology lab for definitive diagnosis, as well as a subsequent quest to stage the cancer using a set of scans. Although categories themselves are constantly being redefined (e.g., as new cell surface markers are discovered, or new trial data show different responses of cancer subtypes to particular chemotherapy regimens), at any given moment in oncology practice the *goal* seems to be definitive representation. Ethnographers have shown many contexts in which oncologists are unable to follow this map, in which they need to improvise, but this has usually been formulated as the fault of material or logistical circumstances, not a different kind of rationality (Livingston 2012; Mukherjee 2016; Sanz 2016; Street 2011).

If the ethnographer were to follow the oncologist's tissue sample into the pathologist's laboratory, it would quickly become clear that the pathologist's process for determining diagnosis is full of its own uncertainty and contingency. But even there, at the end of looking at a set of slides and running a set of molecular surface marker tests, the pathologist writes a report, forcing the diagnosis into a definitive category to hand back to the oncologists (Sanz 2016). The same is true to some degree in radiology, though there is much more dialogue between radiologists and oncologists before the cancer stage is determined (Saunders 2008).

But in the CCU that night, we could not think like oncologists—we could not assume that our patient had a single species of disease that must be ascertained to deploy an algorithm. Mr. Rizzo's body was instead always already changing. As Dr. Moroz summarized: "He's really at the edge right

now. If we can stay ahead of the eight ball overnight, we might be able to pull him out of it." He didn't say, "If we can figure out what Mr. Rizzo really has, once and for all, we can make the definitive move and cure his disease." We were not in the business of knowing, we were in the business of staying ahead, of forecasting, playing at probabilities, and ultimately acting in response as much to the effects of our own decisions as the disease in Mr. Rizzo's body. We were existing in what Simimian-Darash and Rabinow would call a "mode of uncertainty" (Samimian-Darash and Rabinow 2015), managing uncertainty in the flow of time. Most importantly, our great enemy was inaction, which would lead to death. So we did what it took to suspend our uncertainty so that we could act.

According to Dr. Moroz, an important component of avoiding paralysis was "to have more data to work with," to have a data-rich environment. Even if the PA catheter didn't provide us with a definitive representation of a disease process, Dr. Moroz felt that the *data richness* generated by the device made him more confident moving forward with a decision.

This is not to say that such shades of grey pervaded every aspect of our mental constructs. In fact, in Mr. Rizzo's case, one could say that the disease categories of heart failure and sepsis themselves (that I explained above as though I take them as unquestioned truths) were vitally important unquestioned categories facilitating process certainty. The same was true for our understanding of cardiac physiology itself. Even though our physiology equations' assumptions failed to match Mr. Rizzo's body, and our many sources of data gave contradictory results, it never once crossed Dr. Moroz's mind to question whether those models themselves were correct. When I suggested this to Dr. Moroz at a later moment after things had calmed down with Mr. Rizzo's care, he laughed at the absurdity, and said: "You really want to question all of cardiac physiology, here in the middle of the night? Sounds like a way to get nothing done and let the patient die." Introducing grey into the disease categories themselves would have led to total paralysis and was thus dismissed as absurd. But having some uncertainty and flexibility built into the PA catheter was helpful to us, just as a little "looseness" is helpful to jazz musicians in a performance (Wilf 2015).

[h1]"Building a Case" and the Nature of Real-time Data

I ran my explanation of Mr. Rizzo's case by an anthropologist friend, who responded: "What if this logic of suspension is just a feature of the PA catheter, because it produces particularly fuzzy knowledge? Aren't other forms of data much more certain?" This is particularly important to address, since PA catheters themselves have fallen so fully out of favor in most U.S. CCUs by the time I wrote this article that it may no longer be possible to witness the ethnographic moment I describe.

Addressing this requires a journey into the moment when a clinical decision is made, amid the simultaneous flows of urgency and always-partial information that form the reality of medical epistemology. One such moment occurred when I was on the night watch as our hospital's senior consult physician, which involved floating around to help care for the sickest or most confusing patients on ordinary hospital floors (i.e., not yet needing the intensive care unit), providing an extra set of ideas for the clinicians trying to solve precarious problems. I received a page from a medical resident, Dr. Balanchuk, asking: "Can I run a patient by you?"

I took a few moments to read about the patient in the chart. Her name was Ms. Stanger, and she had come to a nearby hospital with difficulty breathing. On arrival to their emergency department, she was found to have low oxygen in her blood, and placed on a special high-flow oxygen mask, partly because the chart mentioned that on one occasion she had expressed not wanting to be intubated or go to the intensive care unit, though she had never ratified that wish into a formal document. She was 71 years old, and had had cancer many years before, for which she had received chemotherapy that had damaged her heart, so that she now had very poor heart pump function, leading to heart failure.[3] She also had a history of abnormal rhythms in her heart (atrial fibrillation and a poorly defined supraventricular tachycardia). From her physical exam and history, the emergency physicians at the nearby hospital decided that she was likely in heart failure, so they gave her diuretics to offload fluid from her heart. They then transferred her to our hospital, since that was where she received her regular cardiology care and since they felt out of their depth with how sick she was.

When I arrived to help, Dr. Balanchuk was outside Ms. Stanger's room at a computer with a pile of papers next to him, presumably the records from the other hospital. I immediately went into Ms. Stanger's room. She was somnolent and confused, struggling to breathe despite her high-flow oxygen. I held her hand for a moment and introduced myself. To my touch, she was neither hot nor cold. Her blood pressure was reasonable (110/65), but her heart rate was shockingly high, in the 170s (a normal maximum heart rate for her age should have been 150, meaning that her heart was working dangerously hard). I listened to her lungs, which sounded normal and dry, but her neck veins were distended with extra fluid, so it was difficult to say whether she was fluid overloaded.

I went back outside and asked Dr. Balanchuk, "Where are you in your thinking?" At the time, my mind was churning through possibilities and I wanted to make a decision quickly. The fastest way to accomplish this was for him to tell me exactly what he already knew and had already thought. I realized that my question to Dr. Balanchuk would spur him into talking about rhythm and tempo in decision-making, to summarize his thinking at an exact moment in time in the midst of a (continuous, punctuated) stream of ever-updating data and interventions. I had recruited him to my study on medical decision-making several months before, so he was not surprised when I turned on my audio recorder and instructed him not to mention identifiable patient information while we talked. After this brief moment, we ignored the recorder, shifting into saving Ms. Stanger's life as our only agenda.

"The thing I'm most worried about," he said, "is her heart rate. It's so high, she can't survive like this for long. The problem is," he said, showing me her electrocardiogram (EKG), "that her heart rate is too fast, so I can't tell from her EKG whether she is in sinus tach [a normal fast heart rate]"

I interrupted him to clarify his thinking: "meaning that she's septic [systemically infected]." A systemic infection can drop the blood pressure, and the heart may then speed up to compensate and keep blood pressure up.[4]

"Right," he continued, "and she needs her heart rate to maintain her blood pressure. *Or*, she might be in an SVT [an abnormal rapid rhythm], and her bad heart doesn't like the fast rate, and so she's in cardiogenic shock from the heart rate."

So, either her heart rate was the problem, going abnormally fast and potentially killing her; or there was another problem, an infection, and the fast heart was keeping her alive.

"What else do you have going for each theory?" I asked.

He said:

> Well, she's neither cold nor hot on exam, so that doesn't help. Her lungs sound dry but her neck veins are up, so that doesn't help. Her chest X-ray has a mucky left lower lobe [i.e., possible pneumonia], so that goes for infection, not heart failure. But her ABG [arterial blood gas] doesn't look infected,[5] and she's super hypoxic, so those both go for heart failure. On her labs, she has a leukocytosis, which goes for infection, but she has an elevated BNP [brain naturietic peptide] and transaminases [liver function tests], which go for heart failure. Her lactate level is pending. So I can't decide. … I really want her lactate [a sign of systemic infection]—that would tip the balance for me.

One need not understand the technical details of this monologue to note that Dr. Balanchuk, in trying to decide what to do for Ms. Stanger, was thinking with a table in his mind, weighing pieces of data on each side of a balance sheet. If I had made him write out this table, it might have looked something like this:

Piece of Data	Distributive (Infection)	Cardiogenic (Arrhythmia)
Physical Exam	equivocal	equivocal
Electrocardiogram	equivocal	equivocal
Chest X-ray	x	
Arterial Blood Gas		x
Basic Labs	equivocal	equivocal
Lactic Acid (Lactate) Level	*pending*	*pending*

The purpose of his balance sheet was to try to "tip the balance," a heuristic for which he was very desperate, not because he would then know definitively what was wrong with her, but because it would allow him to make an initial move. He needed to suspend his uncertainty enough to act. Once he acted, he could see the results of his initial move, and then readjust based on those results.

So why not just pick a tack at random and move forward? Because the stakes of the initial move were very high. At the time, I named this aloud:

> Just to be clear, if she's in cardiogenic shock from an abnormal rhythm, we want to break her rhythm and slow her [heart rate] down. If we don't, her failure will get worse, and we'll have to intubate her, and she could stop defending her blood pressure and crash fast. But if we're wrong, and she's septic [infected] and needs her heart rate to survive, then slowing her down could kill her. And in that case, she needs fluids.

"Exactly," said Dr. Balanchuk. "I just can't put her together enough to build a case and move forward one way or another. I really want that lactate, to have something to go on to make a move."

"How long until the lactate comes back?" I asked.

"I called the lab to make sure they're running it STAT," he said. "Probably ten or fifteen minutes."

We sat in silence for a moment, each trying to decide if Ms. Stanger would live for the minutes it would take for us to get these extra data. While we deliberated, I paged the head of the CCU to let her know we had a patient who needed to be there right away. Dr. Balanchuk phoned Ms. Stanger's family, which he had already done twice, but there was no answer. We briefly considered other ways to make the equivocal pieces of data in our table "pick a side," including the possibility of using a medication to briefly stop the heart, a dramatic measure that can unmask abnormal rhythms, though difficult to execute on short notice and in an unstable patient.

At that point, the nurse came out of the room and interrupted us to say, "her BP [blood pressure] is 90/50 … she's hard to arouse now." This was a clear deterioration, and we needed to act quickly.

I turned to Dr. Balanchuk: "Decision time: What's your vote?"

"I vote we give amio [amiodarone, a medication that can break arrhythmias]," he said. "It could break the rhythm if it's an SVT and won't lower her heart rate too much." He paused, thinking. "What's your vote?"

"I vote for fluids," I said. "If she's septic and we don't give them, she'll die. If we're wrong, we can always intubate her, and she's headed to the CCU anyway."

He paused for a moment. "Let's try amio," he said, "it's kind of a soft move, plus I ran it by the cards fellow before you came, and he liked it. There is mention in her record of her being DNI

[not wanting to be intubated] at some point, so I'm reluctant to commit her to that. Amio will buy us time to wait for the lactate." He paused. "I just need a story [to go on] before I launch full bore one way or another."

I nodded support for him to go with his plan rather than mine, and he wrote the order and told the nurse, who already had the amiodarone by the bedside.

For the purposes of this article, I will forego describing what came next, though there were scenes of vivid intensity and emotion: the drop in Ms. Stanger's blood pressure; her intubation and transfer to the CCU; the CCU's decision to pick sepsis as a running diagnosis (i.e., opposite the tack we had taken) based on the return of a high lactate level; the CCU intern finally reaching Ms. Stanger's family, who were already on their way to the hospital; her family standing at her bedside, present for what they would later call a "sad but peaceful end," each member holding one of her limbs, weeping, unwavering in their conviction that she would not have wanted to be intubated if she were this critically ill, holding their vigil as her endotracheal tube was removed and her breathing stopped.

Instead, I will set those scenes aside to stay with Dr. Balanchuk, paused in his moment of decision. Like in the CCU before, it was a moment in the flow of a terrifying tempo, punctuated by a furious cascade of rhythms, of data hastily assembled, of a disease process changing faster than it could be apprehended. And it was a moment dominated by the pending threat of death, "at the edge" as Dr. Moroz had described it. What was in Dr. Balanchuk's mind in this moment, as he was poised to make a decision? Take, for a moment, the array of data he had before him. No individual piece of data would be considered particularly "fuzzy," as my anthropologist friend suggested. The labs and scans in Dr. Balanchuk's balance sheet were each of high fidelity, with narrow margins of error, each very tightly black-boxed by the world of clinical laboratory science. But their interpretation was manifold based on context, and as an aggregate, they formed a purely grey cloud of possibility. And was Dr. Balanchuk's goal to "know" what was wrong with Ms. Stanger? Instead of that word, he used words

like "building a case," and "having a story to go on," and "tipping the balance" enough to be able to "make an initial move," to achieve *process certainty*. Dr. Balanchuk was on a quest for something to help him *suspend* his uncertainty, to make him confident enough to act. When he was in too-much-uncertainty, before his balance sheet had tipped one way or another, he was paralyzed.

And Ms. Stanger's situation never became known. Dr. Balanchuk never said, "If I just had the lactate level, I would *know* she was septic." The next day, I received an e-mail from him updating me on Ms. Stanger's course after she moved to the CCU. "The CCU decided to pursue the sepsis tack," he wrote, "but she crashed quickly and passed with her family by her side." Even with the lactate level, the CCU's action was still just "pursuing a tack."

Dr. Balanchuk and I had a subsequent e-mail dialogue, but it was not about learning what she "really had," it was simply going over the data that had been available to us at the time, and whether there was anything we should have considered based on that information. Ms. Stanger did not have an autopsy after death, but even such "gold standard" data are generated through a highly subjective process, and though they are reported conclusively, they are mutable based on the clinical situation described by the clinicians caring for the patient. Discussion among clinicians almost always addresses whether appropriate action was taken, given the data on hand at the moment of decision. Elizabeth Cartwright, in an ethnography of the use of fetal monitors in medicalized birthing decisions, drew on Michael Jackson's work on divination to understand a similar phenomenon: "the benefits derived from divination are so great at the time of divination that their ultimate "truth" is rarely called into question" (Cartwright 1998, 250).

It is worth noting the contents of our communication with Ms. Stanger and her family throughout this process. When the CCU team finally reached her family on the phone, they updated them on her situation. Several days later, I asked the CCU intern what she had said, and she summarized: "Your mother has an infection, and her weak heart is struggling to keep up with it. We are treating her for the infection and doing everything we can to support her heart. But you should get

here as soon as you can because it is very precarious." What would have been the utility of sharing with Ms. Stanger's family the uncertainty inherent in Dr. Balanchuk's balance sheet? Or the fact that her life hung in the balance of a few decisions made in the heat of the moment? When I had updated Mr. Rizzo's family about his progress shortly after his arrival at the CCU, I had used similar phrasing, even though the two clinical situations hinged on very different pieces of data. Perhaps the notion that clinical medicine is based on a quest for black-boxing, for knowing what patients have is something that clinicians communicate to patients and families, rather than a dominant feature of the true nature of medical decision-making, just as Favret-Saada showed in her work on witchcraft in France, where belief and knowledge may be categories used to communicate and define worth across social worlds, rather than internally to those making decisions (Favret-Saada 1977). Internal to doctors in the middle of the night, the currency was certainly action rather than knowledge.

[h1]Suspension and Epistemic Uncertainty

These scenes from the CCU reveal an ideal type of medical rationality in which practitioners suspend their uncertainty to keep up with the rhythms of the body. Alongside Molé Liston and Karlin (Molé Liston et al. 2013), I have come to draw on Samuel Coleridge's concept of suspension of disbelief (Coleridge 1985) as a useful way of making sense of this, of modeling action-in-rhythm, for understanding how individuals like Dr. Balanchuk and Dr. Moroz make moves in clinical practice.

Reworking the suspension of disbelief to make sense for medical epistemology requires a few adjustments. Coleridge's concept was invented for literary analysis, and thus tied inevitably to aesthetics and the consumption of art. As such, the key mechanistic force in Coleridge's conception—the force connecting the mind and the outside world—was the imagination, and the thing that needed suspending was disbelief. In this article, I have replaced the notion of disbelief with the concept of uncertainty, more relevant to the CCU. But is it nonsense to talk about the role of imagination in medical decision-making? Following Molé Liston and Karlin, I envision Coleridge's term as providing not only a way of understanding how individuals "project fantasy" (i.e., how they internally

imagine the outside world), but also how they "make reality," turning ideas into material action. In this way, imagination is a creative force. This is precisely what Dr. Balanchuk and Dr. Moroz needed: concepts and pieces of information that could build a case, to "have a story to go on," and to "tip the balance" enough to act (i.e., to effect a reality in the world). In some ways, the ideas necessary for the flow of their medical practice were less like Coleridge's concept of symbols, whose purpose was only pleasure, and more like Lévi-Strauss's, for whom above all else symbols were "effective." For Lévi-Strauss, moving ideas around, putting symbols in a particular configuration, had the potential to create a particular material reality, a healing both of body and mind (Kleinman 1973; Lévi-Strauss 1974; Moerman 1979). This is a similar bridge between ideas and reality that one might find in discussions of the placebo effect (Ostenfeld-Rosenthal 2012), except that in this case the placebo is for the physician. The material (laboratory measurements of bodies, components of physical exam) is made immaterial (a grey cloud of data), which is then made material again in the form of physicians' interventions on the body. And reality can only be made by ideas that are relevant at the present moment in the rhythmic flow of time. This calls to mind Gaymon Bennett's work on the types of rationality that get deployed in contexts of uncertainty, which he names "systems that calculate the future as that which can always be otherwise," arguing that "the value of calculation lies in its endless flexibility. If such calculations turn out to be wrong, they will still be right: the future is uncertain, after all" (Bennett 2015, 126). Only flexible tools are useful in the present for predicting and acting in anticipation of an ever-changing future.

Coleridge's concept is useful for thinking through another aspect of medical epistemology that appears in the moments recounted above: Dr. Balanchuk's balance sheet. As Molé Liston and Karlin have pointed out, suspension provides "a way to make two seemingly antithetical propositions acceptable at the same time." Thus, unlike diagnosis, which would require Dr. Balanchuk to act only once he knew which side of his balance sheet was true, he was instead able to act in the present moment, even while holding the opposite model on which his action was based as nearly-probably-as-

true as the one he had (temporarily) selected. Saler has advocated reimagining "suspension of disbelief" as part of the "ironic imagination," which promises a way to experience wonders and marvels while avoiding enchantment's potential to beguile (Saler 2004). In the context of medical practice, one could think of this "ironic imagination" as allowing Dr. Balanchuk to allow his balance sheet to tip in one direction, without ultimately letting go of the other side. Physicians talk about the vital necessity of avoiding the trap of "diagnostic anchoring" (i.e., of believing one's own or someone else's prior diagnosis too strongly, and thus failing to rewrite the story as new information comes available).

The physician acts "as if" one model is true, but this acting "as if" is an act of creation, of making reality, because the patient's body changes as a result of interventions chosen. If the patient's body "talks back" in a contrary way, then the physician switches and acts "as if" the opposite concept is true. Eventually, the patient's problem is resolved—Mr. Rizzo's physical body is changed (i.e., he gets better) such that neither theory in the balance sheet is needed anymore—and the matter is dropped.

Finally, Molé Liston and Karlin have argued that we are currently living in an era of "epistemic uncertainty." This is as true in medicine as it is anywhere. The 1990s and early 2000s were characterized by an enthusiastic medical culture of evidence-based medicine, an ultra-modern hope that empirical data would find the ultimate truth to every question. This has been followed by a slow deterioration in trust in the ability of evidence to provide either unbiased truths (Ioannidis 2005; Petryna 2005; Prasad et al. 2011) or, in my experience, to inform real on-the-ground medical decisions, which are always fraught with particular details that trump the generalities of research studies. Just as in politics (Parmar 2012), I have seen young medical practitioners begin to swing away from unquestioned reliance on data, and to return to instinct and clinical experience. The types of medical decisions that occurred at Mr. Rizzo's and Ms. Stanger's bedsides are examples of what it

is like to make decisions in such an era, where data, despite being post-modernized, are far from irrelevant.

This exploration of tempo and rhythm in high-stakes medical decisions is meant to be an invitation to think more broadly about the phenomenology of expert rationality in many environments. Given that medical decisions in this U.S. CCU draw on a data-rich environment to resolve paralysis, what is the relationship to data in other life-and-death contexts? What occurs in the mind of a military officer facing a split-second decision about a drone strike, a similarly terrifying and ethically fraught existential moment? The same questions may have relevance for less mortal contexts as well. For example, how do Wall Street traders make second-by-second decisions amid the flow of massive quantities and varieties of available data? What is required for understanding these contexts is a move from studying rationality as a form of representation to one of practice, where expert knowledge is not something possessed but something done in the flow of irreversible time.

Acknowledgments: This article was initially conceived as part of a panel on the suspension of disbelief, and I am very grateful to the participants: Jennifer Karlin, Noelle Molé-Liston, Stacy Pigg, and Mark Robinson. I would also like to thank Raphael Frankfurter, Raymond McDermott, Elizabeth Roberts, and Camilo Sanz for invaluable feedback on drafts of this article. And I thank my anonymous reviewers, who contributed significantly to this article's development. Finally, I owe a great debt to the characters who appear in this article (in pseudonym), who not only allowed me to learn from them during harrowing moments of practice, but also provided generous feedback on drafts to ensure empirical accuracy and conceptual depth.

[h1]Notes

1. All names in this article are pseudonyms.

2. In addition to pseudonyms, all patients in this article have been de-identified through altered demographic information. Moreover, the clinical scenarios presented in this article are extremely common, and thus not traceable to individual patients.

3. In many ways, this background situation was similar to Mr. Rizzo's, though from a different cause.

4. For simplicity of ethnography here, I am leaving out our brief discussion of many other causes of tachycardia and hypoxia, including myocardial infarction and pulmonary embolism, that we discounted based on certain data, though the argument about the 'fuzziness' of 'building a case' that I discuss here also applies to that discussion.

5. Her arterial blood gas showed that her blood was alkalotic from hyperventilation, rather than acidic, which would have indicated a systemic infection.

[h1]References

Bennett, G. 2015. The Malicious and the Uncertain: Biosecurity, Self-justification and the Arts of Living. In *Modes of Uncertainty: Anthropological Cases*, edited by L. Samimian-Darash and P. Rabinow, 123–44. Chicago: University of Chicago Press.

Bourdieu, P. 1972. *Outline of a Theory of Practice*, translated by R. Nice. Cambridge: Cambridge University Press.

Cartwright, E. 1998. The Logic of Heartbeats: Electronic Fetal Monitoring and Biomedically Constructed Birth. In *Cyborg Babies: From Techno-sex to Techno-tots*, edited by R. Davis-Floyd and J. Dumit, 240–54. New York: Routledge.

Certeau, M. de. 2011. *The Practice of Everyday Life*, translated by S. Rendall. Berkeley: University of California Press.

Coleridge, S. T. 1985. *Biographia Literaria: The Collected Works of Samuel Taylor Coleridge, Biographical Sketches of My Literary Life & Opinions*. Princeton, NJ: Princeton University Press.

Dewey, J. 1929. *The Quest for Certainty: A Study of the Relation of Knowledge and Action*. Gifford Lectures 1929. New York: Minton, Balch & Company.

ESCAPE Investigators. 2005. Evaluation Study of Congestive Heart Failure and Pulmonary Artery Catheterization Effectiveness: The Escape Trial. *JAMA* 294: 1625–33.

Favret-Saada, J. 1977. *Deadly Words: Witchcraft in the Bocage*. New York: Cambridge University Press.

Fox, R. C. 1957. Training for Uncertainty. In *The Student–Physician: Introductory Studies in the Sociology of Medical Education*, edited by R. K. Merton, G. G. Reader, and P. Kendall, 207–41. Cambridge, MA: Harvard University Press.

Good, B. 1994. *Medicine Rationality and Experience*. Cambridge: Cambridge University Press.

Heidegger, M. 2008. *Being and Time*. Reprint edition. New York: Harper Perennial Modern Classics.

Ioannidis, J. P. A. 2005. Why Most Published Research Findings Are False. *PLOS Med* 2: e124.

Kirsch, T. G. 2004. Restaging the Will to Believe: Religious Pluralism, Anti-syncretism, and the Problem of Belief. *American Anthropologist* 106: 699–709.

Kleinman, A. M. 1973. Medicine's Symbolic Reality. *Inquiry: An Interdisciplinary Journal of Philosophy* 16: 206–13.

Klemp, N., R. McDermott, J. Raley, M. Thibeault, K. Powell, and D. J. Levitin. 2008. Plans, Takes, and Mis-takes. *Outlines. Critical Practice Studies* 10: 4–21.

Latour, B. 1988. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.

Latour, B. 1999. *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press.

Lefebvre, H. 2004. *Rhythmanalysis: Space, Time, and Everyday Life*. London: Continuum.

Lévi-Strauss, C. 1974. *Structural Anthropology*. New York: Basic Books.

Lindquist, G., and S. Coleman. 2008. Against Belief? *Social Analysis* 52: 1–18.

Livingston, J. 2012. *Improvising Medicine: An African Oncology Ward in an Emerging Cancer Epidemic*. Durham: Duke University Press.

Mattingly, C. 1998. In Search of the Good: Narrative Reasoning in Clinical Practice. *Medical Anthropology Quarterly* 12: 273–97.

McTaggart, J. E. 1908. The Unreality of Time. *Mind* 17: 457–74.

Moerman, D. E. 1979. Anthropology of Symbolic Healing. *Current Anthropology* 20: 59–66.

Mol, A. 2002. *The Body Multiple: Ontology in Medical Practice*. Durham: Duke University Press.

Molé Liston, N., J. Karlin, S. D. Stonington, and M. Robinson. 2013. Suspension of Disbelief. Presented at the American Anthropological Association Annual Meeting, November 21.

Mukherjee, S. 2016. The Improvisational Oncologist. *The New York Times*, May 12.

Needham, R. 1972. *Belief, Language, and Experience.* Oxford: Blackwell.

Ostenfeld-Rosenthal, A. M. 2012. Energy Healing and the Placebo Effect. An Anthropological Perspective on the Placebo Effect. *Anthropology & Medicine* 19: 327–38.

Parmar, I. 2012. US Presidential Election 2012: Post-truth Politics. *Political Insight* 3: 4–7.

Petryna, A. 2005. Ethical Variability: Drug Development and Globalizing Clinical Trials. *American Ethnologist* 32: 183–97.

Prasad, V., V. Gall, and A. Cifu. 2011. The Frequency of Medical Reversal. *Archives of Internal Medicine* 171: 1675–76.

Saler, M. T. 2004. Modernity, Disenchantment, and the Ironic Imagination. *Philosophy and Literature* 28: 137–49.

Samimian-Darash, L., and P. Rabinow, eds. 2015. *Modes of Uncertainty: Anthropological Cases*. Chicago: University of Chicago Press.

Sanz, C. 2016. (Dissertation) Oncopolitics of Deferral and Temporal Urgency: Health Insurances, Biomedical Practices and Cancer in Colombia. Ph.D. Dissertation, University of California, Davis.

Saunders, B. F. 2008. *CT Suite: The Work of Diagnosis in the Age of Noninvasive Cutting*. Durham: Duke University Press Books.

Street, A. 2011. Artefacts of Not-knowing: The Medical Record, the Diagnosis and the Production of Uncertainty in Papua New Guinean Biomedicine. *Social Studies of Science* 41: 815–34.

Wilf, E. 2015. The "Cool" Organization Man: Incorporating Uncertainty from Jazz Music into the Business World. In *Modes of Uncertainty: Anthropological Cases*, edited by L. Samimian-Darash and P. Rabinow, 29–45. Chicago: University of Chicago Press.