

Cognition in Nurse Triage at a Health Clinic

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INTRODUCTION

The prevalent use of computer systems in medical settings is part of a general shift in medicine towards the digitization of information and the incorporation of digital technologies into medical practice (Heath & Luff 2003). In the U.S., this shift has significant institutional support including incentives for the purchase of Electronic Medical Record (EMR) systems, the implementation of health information exchange programs, and investment in research and development of health information systems (HITECH 2009). Such political and technological changes are likely to have significant effects for health care delivery and workflow in settings like hospitals and clinics (Hazelhurst 2008). In high-stakes medical environments where safety and efficiency are critical, it is important to understand the organization and context of care delivery when implementing institutional and technological changes to support and encourage quality care (Hazelhurst 2008, Franklin 2011). Unfortunately as Heath and Luff report, there is a “growing recognition that we know little about the ways in which people use mundane artefacts in ordinary situations, let alone complex computer systems.”

Recent developments in digital technology and Cognitive Science have begun to bridge this gap by making possible the study of cognition in complex medical settings (Hollan 2010, Hazelhurst 2008). This ethnographic study examines one such setting, a community health clinic, focusing on the triage of “walk-in” patients. As an adaptive function of the clinic, triage allows it to evaluate and treat unscheduled patients on the fly. Using ethnographic observation and video recordings, we were able to analyze the unfolding of triage decisions in the clinic activity system. The cognitive processes involved in performing triage are identified as configurations of the clinical staff and technologies that determine what the patient’s need is and whether the clinic can meet it. By showing how these processes are embedded in the larger social and technical organization of the clinic, we hope to inform efforts that support health care practice with an account of the cognitive complexity in such settings.

BACKGROUND

In the broadest sense, triage in medicine is defined as “the distribution of medical resources to patients... determining who receives treatment and who does not” (Iserson 2007). Triage most commonly refers to the sorting of patients by priority in emergency situations, such as in an

Emergency Department (ED), on the battlefield, or following a large-scale disaster. Iserson lays out three requirements of triage: 1) At least a modest scarcity of health care resources exists, 2) each patient’s medical needs are assessed by a health care worker, 3) an established system determines specific treatment or treatment priority for each patient. As such, triage also occurs in non-emergency health care situations where resources are scarce. The health clinic where this study took place performs triage daily to meet the needs of “walk-in” patients who come to the clinic without appointments.

The clinic mainly provides primary care physician appointments that are scheduled months in advance. However, many patients show up unscheduled and requesting care. These requests require resources not anticipated by the schedule for a day, and pose a “snag in the ongoing course of activity” (Lave 1984). Legally, medically licensed professionals must evaluate patients who come to a medical facility seeking care. Registered Nurses (RN) are responsible for filling this gap in capacity by triaging patients, assessing their conditions and determining what kind of treatment can be provided given the clinic’s capability at the time. Additionally, a few “same-day” appointment slots are reserved each day for these requests. These accommodations provide the clinic with some flexibility to handle patients with unscheduled medical concerns. While not as high-stakes as an emergency department, the triage process at the clinic is very complex and involves the dynamic assembly of resources and constraints to assess who can or cannot be given care.

Viewing the clinic as a cognitive system allows us to ask how the clinic makes triage decisions and what the processes are by which “information is represented and how these representations are transformed, combined and propagated” to produce triage decisions (Ackerman 1998). In doing so we adopt the theoretical framework of Distributed Cognition, which provides us with the flexibility to choose a unit of analysis that suits the phenomenon of interest (Hutchins 1995). In studying the triage function, our unit of analysis is the clinic activity system that consists of clinicians, technologies, and a material clinic setting. By focusing on an activity system, we make visible how cultural practices shape the interactions and flow of information within the clinic to make triage decisions.

This approach has been applied to a number of health care settings such as EDs and other health clinics. Chen's study of documentation practices in an ED showed how clinicians used informal "transitional artifacts" such as slips of paper, whiteboards, and paper charts to bridge a gap between the events at the ED and their formal documentation in the EMR (Chen 2010). In a health clinic transitioning to a digital workflow, Vinkhuyzen chronicled how introducing EMR and document-scanning systems redistributed administrative work from clerks to physicians (Vinkhuyzen 2012). Franklin's investigation of task transitions in the ED showed how physicians' decisions about what to do next are often influenced by opportunistic events such as interruptions (Franklin 2011). By highlighting how health care is shaped by situated social practices and technologies, these studies show that activity systems are a productive unit of analysis for understanding these settings. Our study seeks to add to this line of studies by focusing on the process of triage in a clinical activity system.

METHODS

Considering the clinic as a distributed cognitive system recognizes that much of the system's processing occurs in the flow of representational states across individuals and technology (Hutchins 1995, Ackerman 1998). Cognitive Ethnography provides a methodology to track and capture this flow in real world settings by examining the moment-to-moment construction and use of knowledge in cultural activity systems. Building upon the anthropological method of ethnography, which involves both observing and participating in cultural groups, cognitive ethnography uses digital recording devices to capture the unfolding of events in rich and fine-grained detail. These recordings are then transcribed and analyzed as situated instances of cognitive activity (Hutchins 1995, Williams 2006, Hazelhurst 2008). Unlike a traditional ethnography however, this study was primarily observational, as the researcher has neither the qualifications nor the authority to be participating in any clinical activities.

Setting

The setting for this study is a local non-profit community health clinic. The clinic provides primary care medical and mental health services, with small lab and pharmacy facilities on site. Members of the clinic include physicians, nurses, medical assistants, lab technicians, and residents and medical students in training. The patient base is multi-ethnic, and as such there are translators available at the clinic for a number of languages including Spanish and Vietnamese. EMRs have been used for all patient encounters since 2010.

The focus of this study is the triage process that takes place in the adult care building of the clinic. This building consists of a lobby and front desk area connected to a back office that has exam rooms, a nurse's station, and a lab. The nurse's station is a partially enclosed desk area central to

the back office that has multiple EMR systems, reference documents and forms, and office equipment (printers and scanners). Nurses and medical assistants often communicate with each other, physicians, or patients, while at or around the nurse's station.

Data Collection and Analysis

The study took place under an approved IRB research plan with the authorization of the clinic. 15 clinic observations were made over the course of 10 weeks, on both weekdays and weekends for around 80 hours in total. Data collected included observations, field notes, paper forms, interviews, and audio/video recordings. Observations were initially conducted throughout the clinic to develop familiarity with the general workflow, and later focused on shadowing nurses performing triage in the back office. For privacy reasons, the researcher did not follow nurses when they were consulting with patients. Field notes were taken to capture the structure and sequence of triage events, and while the researcher asked for clarification and encouraged nurses to "think-aloud" at times, efforts were made to not disrupt their clinical work. Audio and video recordings captured activity at the nurse's station, focusing on their interaction with each other, the EMR system, and paper documents. Five video recordings were made on weekends towards the latter part of the study, averaging around 1 - 3 hours per day. Finally, interviews were done with administrators, physicians, nurses, and medical assistants at the clinic or over the phone. Informed consent was obtained from the clinical staff before video recordings and interviews, and any patient's personally identifiable information captured in the data was removed to protect their confidentiality. In the following analysis, clinicians' and patients' are given pseudonyms for anonymity.



Figure 1. The nurse's station at the clinic.

Data Analysis

The five video sessions were imported into ChronoViz, a visualization tool that aids the analysis of time-coded data (Fouse 2011). Video data were first indexed to roughly characterize the types of nurse activity into five categories: triage, follow-up work, other work, organization space, and work-unrelated interaction. Segments where nurses were

dealing with triage patients were then highlighted for further analysis.

From the observations, field notes, and the video data, a competence model was created to describe the general structure and information requirements of the triage function. This general model describes the types of information that can be relevant to making triage decisions and where they are represented in the clinic. This model was then used to frame individual triage cases identified in the video data as instantiating certain elements of the competence model. Two cases in particular were selected for detailed analysis based off their completeness.

COGNITION IN TRIAGE

Triage decisions are reached by determining the fit between a patient's needs and the ability of the clinic to meet that need. The overall assessment of a patient by the clinic, though sometimes ill defined and uncertain, implies a course of action (a treatment plan) for treating or further investigating their condition. This treatment plan, based off the practices and procedures for dealing with medical conditions, requires a set of resources in order to be performed. The degree to which the clinic can meet these requirements of the treatment plan (the clinic's capacity) entails decisions about if and how the patient's needs can be met. These triage decisions largely consists of four types, corresponding to different fits of the patient's need and the clinic's capacity: 1) the patient is turned away for mild or benign conditions, 2) turned away due to lack of capacity and offered a later appointment or directions to another clinic, 3) treated at the clinic, 4) or redirected to another health care facility for specialized or emergency care.

The case studies detailed in this section pertain to a particular type of medical request, prescription refills. RNs are not licensed to prescribe controlled medicines, and their ability to prescribe uncontrolled medicines is subject to specific agreements between providers and nurses. These local agreements, or clinic policies, are guidelines for nurse refills pertaining mostly to the types of medication being requested and how often providers must manage them. A nurse may easily refill mild or standard medications such as asthma inhalers, while others that must be monitored and managed such as pain medications require the approval of a provider familiar with the patient. If a patient is regularly in contact with a provider the nurse may refill their medication until the patient's next appointment and be compliant with policy; if the patient is more sporadic they may deny or defer to the provider. Additionally, the nurse can use her own judgment to evaluate these constraints and determine the urgency of the patient's need.

As a distributed cognitive system, information relevant to the triage decision is represented throughout the clinic in people, artifacts, and environments. This analysis focuses on how these representations are generated, transformed,

combined, and propagated in order to make these decisions (Ackerman 1998). The following sections detail different configurations of the resources in the clinic that constitute distributed cognitive processes: attention, memory & interpretation, decision-making, and problem solving, which support the production of triage decisions.

Clinical Attention

Checking In

When a patient arrives at the clinic they check in at the Front Desk and are asked why they came. If a patient has an unscheduled medical request, the front desk must first determine if that patient meet certain triage criteria. For example, the clinic does not give same-day appointments for workplace injuries, car accidents, and disability evaluations¹. If a patient does not meet these criteria, they can be turned away or directed to another health care facility. If they do meet the criteria, patients are then asked to fill out a triage form (referred to as a slip). Some of the fields are straightforward and factual (Name, Date of Birth, Time), while others are more complicated or up to the interpretation of the patient (Insurance, Reason for Visit). The patient is then told to wait in the lobby while the front desk staff walks the triage form to the nurse's station and places it on a clip by the nurse's desk.

Request To Speak With A Nurse
(Forma para consultar con la enfermera)

Date (Fecha): _____ Time (Hora): _____

Name (Nombre): _____

Date Of Birth (Fecha de Nacimiento): _____

Insurance (Seguro Médico): _____

Telephone (Número de Teléfono): _____

If this is concerning a child (under the age of 18) are you the guardian/parent? (Si esto es referente un niño, menor de 18 años, ¿es Ud. El Guardián/Padre?) Y/N (SI/No)

Please state the reason for this request (Por favor, explique para qué quiere Ud. esta petición): _____

Is this your first visit to Linda Vista Health Care Center? Y/N (¿Es esta su primera visita a la clínica Linda Vista?) SI/No

If no, when were you last here? (Si no, cuándo fue su última visita?) _____

Are you allergic to any drugs? (Tiene Ud. alergia a alguna medicina?) Y/N (SI/No) If yes, please list (Si Ud. tiene alergias, por favor, de el nombre de las medicinas): _____

Do you have any chronic health problem? (¿Tiene Ud. una enfermedad crónica?) Y/N (SI/No) If yes, please list (Si la respuesta SI, por favor, explique): _____

Figure 2. The Triage Slip

Case Studies: Teresa and Mark

The following analysis will focus on two triage events on a Saturday at the clinic. Janice is an English-speaking nurse assigned to work the full day and Maria is a bilingual English and Spanish-speaking nurse assigned to work during the morning.

¹ These requests are often linked with legal claims, and require specialized documentation by a trained practitioner.

Mark is an English-speaking patient who comes in to the clinic at 12:13pm without a scheduled appointment, requesting a refill on a medication prescribed to him during an ER visit. His slip reads, “Need a refill on blood pressure medicine prescribed in the ER. Don’t have a doctor”.

Teresa is a Spanish-speaking patient who comes in to the clinic at 12:56pm without a scheduled appointment, requesting a refill on a medication prescribed at the clinic. Her slip is written in Spanish, reading “Sacar Medicamento De Walmart Pharmacy” (Get medication from Walmart Pharmacy) and “Anciecao extrema por ifanos oy nececito [medication] de 50 mg” (Need 50 mg [medication] for extreme anxiety). Both patients’ requests meet the triage criteria, and their triage slips are walked back to the nurse’s station.

Attention

Attention is commonly referred to as the allocation of processing resources to specific information. The front desk’s classification of patients and production of triage slips is a form of attention that structures the clinic’s perception and management of the patient. When a patient arrives at the clinic, the front desk is responsible for determining their need and directing them towards the appropriate resources at the clinic. Their initial reception of patients is tailored towards classifying them as either scheduled or unscheduled for an appointment, a coding scheme that reflects the organization of work at the clinic (Goodwin 1994). The patient’s expression of an appointment status with the clinic can be confirmed with the EMR system in order to check the patient in. If they do not have an appointment with the clinic their requested is coded further, to determine if they meet the triage criteria. Both Mark and Teresa do not have scheduled appointments for that day and are requesting refills on medications, conditions that trigger the initiation of a triage case.

Filling out the triage slip is the first step in the triage process. Patients fill out this simple form, generating a written representation of their demographic information and current request. As a “structure of intentionality”, the triage slip serves as a filter that structures clinic’s perception of the patient. The form and the fields on it organize patients’ representation of themselves, capturing certain kinds of information relevant to evaluating their case (Goodwin 1994). This representation is static, easily mobile, and much simpler to deal with than the patients themselves. A nurse reading the slip encounters a specific set of information decoupled from the complexity of a face-to-face interaction with the patient and can thus begin evaluating triage cases on their own time.

Once filled out, triage slips are passed across a boundary (the locked door) into a tightly controlled space where nurse work happens, while patients wait in a less controlled waiting space. Placing the triage slip on the clip at the

nurse’s desk is an asynchronous notification that buffers an indication of the presence of a new triage patient without interrupting nurses who may be busy with consulting with patients or performing other tasks. As triage patients come in, these slips “stack up” in the buffer. Nurses can pull these stacks and review them, considering a preliminary sketch of each patient and what triage decisions might look like. The slip has the affordances of paper documents, allowing them to be written on, stacked, ordered, and splayed out. For Mark’s case, his slip provides general information about his request without details such as which ER he visited, what he was seen for, and what medication he was prescribed. Teresa’s slip provides more detailed information about her request but is written in Spanish, a language barrier that limits access to the information on the slip. As she sorts through the slips, Janice can overview the patients requesting care without investing in interaction with any patient to “get a sense of what [she’s] dealing with”.

Clinic Memory & Interpretation Formation

Reviewing the slips

Upon receiving and reading the triage slip, nurses often review the patients’ medical record and form a rough interpretation of their needs. The patient’s name and date of birth is used to search the EMR database for the patient’s record. Upon identifying the record, nurses check the past documented encounters of the patient with the clinic for information that may be related to the current request such as past diagnoses, previous treatments and prescriptions, or other relevant clinical information about the patient. With this information, and any personal knowledge they may have about the patient, they can form a preliminary interpretation of the patient’s condition and the relevant care they have received at the clinic. This interpretation also allows them to assess the clinic’s capacity for treating the condition and begin to determine what the triage decision might be.

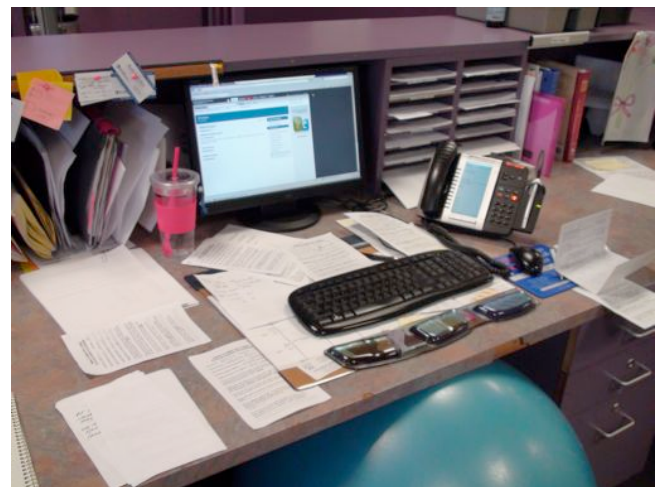


Figure 3. Detail of a desk at the nurse’s station, with EMR display and Triage slips

Case Studies: Teresa and Mark

Reviewing Teresa's slip, Janice enters her date of birth in the patient lookup window of the EMR. She selects Teresa's name, which opens up a patient "hub" (a portal to various kinds of information about the patient). She selects the "encounters" button, which opens up a window displaying a list of all the documented interactions of the patient with the clinic. Upon inspecting the list of visits she concludes that the last time the patient was seen for anything related to her medication request was about 6 months prior.

Reviewing Mark's slip, Janice looks up his date of birth in the EMR. Upon receiving no results she concludes, "he's a new patient". Previously when reviewing another patient, she had mentioned that "new patients take 30 minutes" and that the schedule for the day was already full. Identifying Mark as a new patient she comments, "we're not going to be able to see him".

Memory & Interpretation

Neisser defines memory as "the use of past experiences in meeting the present and future". In the examples described above, the configurations of the triage slip, nurse, and EMR functions as a clinical memory. However as Ackerman points out, this organizational memory is not a single monolithic entity, but "many small memories" which in this case are contextualized and woven together to reconstruct the clinical history of the patient and situate the preliminary assessment of the patient.

In addition to capturing specific information about patients, the triage slip also serves as a local short-term memory by holding it until the nurse is available. More broadly, the triage slip is also as a crystallized memory of the triage process and the types of information that are relevant to evaluating triage cases. Two crucial pieces of information captured by the triage slip, the patient's name and date of birth, are necessary to look up their record in the EMR. These pieces of information on the slip are coordinated with the EMR through the nurse's short-term memory resources. The EMR system can be considered a longer-term global memory of the clinic for its patients and appointments, with a database of personal information, past appointment notes, and medications/treatments. This clinical memory continually accumulates as clinicians interact with patients and document those interactions.

In Teresa's case, while the nurse does not know all the details about the patient's request, she knows there are a few important constraints on the policy and protocol for nurse refills. The medication the patient wants refilled is written on the slip, but the nurse does not recognize this and begins to evaluate information that she does have access to. Her use of the EMR is geared towards investigating the time since the patients' last appointment in order to gauge the regularity with which the patient has been seen. She

reconstructs the patient's clinical context, reading down the list of appointments: the last appointment was missed (indicated by the pink color of the font), the previous appointment was an annual visit which likely would not be related (indicated by the appointment details), the one before that was a same-day appointment focusing on breast pain (indicated by the appointment details), and so the last relevant appointment was 6 months prior. While she does not know what medication the patient wants refilled, this investigation allows her to formulate a rough interpretation of the patient's situation that she notes may be a stretch on her ability to refill any medications.

The nurse's ability to create this interpretation takes advantage of the clinic's stable practices of treatment and documentation in both providing the records of interaction and the means for interpreting them. All clinical interactions with patients must be documented; the encounters list in the EMR allows her to quickly investigate these interactions. Reading down the list, she can read the date of the appointments and infer the likely content of each visit from small cues such as the color of the font and the details of the appointment type. These inferences: that pink means missed appointment, that annual visits are not counted as relevant, and that same-day appointments usually do not cover more than one topic, are all grounded in the social conventions of operation at the clinic. The EMR provides additional structure in the ways these interactions are documented, capturing certain information such as the appointment type and patient's attendance for the appointment, and in the ways that these interactions are presented, displaying certain information in the encounters list.

This representation of the collective documentation of the clinical staff consolidates a wealth of information, but understanding the meaning of that information requires familiarity with medical practice and the local conventions, rules, and systems of the clinic. In her use of the EMR, the nurse uses her longer-term memory and "professional vision" of clinic practices, medical knowledge, and personal experience to interpret the information it contains (Goodwin 1994). She uses her professional vision in reading the triage slip as a representation of the patient's request and navigating the EMR to the relevant clinical history of the patient to place the triage slip in context by reconstructing the clinic's 'memory' for the patient.

In Mark's case querying the patient's date of birth produces no results, which indicates that the EMR has no record for the patient. From this the nurse concludes, "he's a new patient". In the context of the clinical procedure of creating an EMR profile for all patient encounters, the lack of a profile implies that the patient has not been seen at the clinic before. As a new patient, clinic policy requires Mark be seen by a physician before prescribing or refilling any medications. Further, the lack of open slots for this patient

to see a physician means this is not an option. With these constraints specified, she forms another rough interpretation “we’re not going to be able to see him... he’s not going to be happy”.

The clinic’s memory for its patients is thus not simply transferred from the EMR to the nurse, but is co-produced from the EMR’s database and the nurse’s knowledge of clinical practices. The decontextualized and sometimes sparse representations of the patient’s requests on the triage slip are juxtaposed alongside more structured representations of their clinical history. This allows the nurse to situate and recontextualize patient’s request through her interpretation of their clinical history as recorded in the EMR. This memory process occurs through the active manipulation and interpretation of static representations over which the nurse has control, and often happens before she consults with the patient. Thus when she encounters the patient, she can have an interpretation of their situation and a sketch of the relevant constraints on the clinic’s capacity to meet their need.

Clinic Decision-Making and Problem Solving
The Triage Decision



Figure 4. A simplified schematic of triage constraint satisfaction.

Once a patient’s clinical history and a rough interpretation of their condition has been established, the nurses call them into the back office for a consultation. The nurse may further investigate the patient’s condition and history, any physical symptoms they may be presenting, and inform them of the treatment options the clinic can provide. The clinic’s legal, administrative and medical policies, and types of medical professionals, staff, and equipment available, all provide a set of “hard” constraints on the type of treatment which the clinic can provide. These constraints limit not only the clinic’s treatment capability but also their ability to assess the patient’s condition². In addition to these more structural limitations, the clinic has finite resources for performing work on any given day. The staff assigned to work and the schedule of appointments for that day provide additional constraints on who can be available to provide treatment. The “soft” assembly of a treatment plan for a patient depends both on the static “hard” constraints of the clinic and on the more dynamic “soft” constraints of the resources available as the day of work unfolds. In these

² For example, the clinic does not have an X-Ray machine and thus has little ability to determine whether certain injuries are fractures or sprains.

situations, triage decisions emerge from the negotiation of a treatment plan to address the patient’s condition with the clinic’s capacity.

Clinical Decision-Making: Teresa

After Janice determines that Teresa’s last relevant encounter at the clinic was 6 months prior, Maria offers to take over the triage for her. However, Teresa briefly leaves the clinic and is nowhere to be found when Maria calls her in for a consultation. Only assigned to work half of the day, Maria hands the case back to Janice before she leaves. After Teresa returns to the clinic, Janice recruits the front desk to ask her what medication she wants refilled. The front desk returns with the medication’s name, dosage, and Teresa’s report that she was told to come back to the clinic when she ran out. Janice looks up the medication in the EMR, which shows that it was stopped a year prior, conflicting with Teresa’s story. Unfamiliar with the drug, Janice searches an online database and finds that it is commonly prescribed for depression and should not be stopped abruptly. This causes Janice confusion and she conservatively decides to deny the request today and request approval from Teresa’s assigned provider.

Teresa’s request falls well within the clinic’s medical capabilities. She is an established patient at the clinic requesting a refill on a medication prescribed at the clinic. However as a walk-in patient, Teresa’s request is sent to a nurse who has little familiarity with Teresa’s clinical history. Janice reconstructs some of this context by soliciting the medication name from the patient, reviewing the prescription history in the EMR, and searching for the medication in the online database. Her unfamiliarity with the medication, the conflicting report on its management from Teresa and the EMR, and the 6 months since Teresa’s last relevant visit stretches the nurse’s comfort on administering a refill. Unable to clearly tack down the history or the mechanism of the medication, she decides not to push her limits and consult the assigned provider, postponing and effectively denying the refill today.

At this point another nurse, Maria, returns to the clinic to pick up an item she forgot. Janice informs her about the patient, her medication, and asks her, “Would you do that one? I don’t feel comfortable...” Maria answers that she is not familiar with the medication and advises Janice, “I would run it by Dr. Stevens”. Janice takes her advice and presents the case to the doctor, informing him of the patient’s assigned provider, the name of the medication, her lack of insurance and missed appointments, and the date of her next appointment. The physician, familiar with the drug, approves the refill commenting, “it’s pretty mild”.

Clinical decision-making in this case is distributed across the two nurses and the doctor, shifting at first from a decision to deny the refill to an approval with the doctor’s consent. Unsure of her decision, Janice takes Maria’s return

to the clinic as an opportunity to get her advice on refilling the medication. However she too was unfamiliar with it and suggests Janice take the case to Dr. Stevens. Maria's advice provided little additional information, but suggested an authoritative resource that could bring clarification. Her unplanned return to the clinic prompts the opportunity for Dr. Stevens to be included in the decision-making process. A senior physician, his familiarity with the medication reduces the uncertainty in the assessment, and his understanding of its potency sways the decision in the opposite direction. Additionally, his authority as a physician shifts the burden of accountability shifts from Janice, who then carries out the refill as a "VO [verbal order]". The triage decision thus emerges out of the interaction of the two nurses and Dr. Stevens with Teresa's case, with the knowledge of the specific medication being a crucial factor.

Clinical Problem-Solving: Mark

As a new patient, fulfilling Mark's request will not only take more time but will require a physician's time. With a fully booked schedule, this is not an option today. Janice asks the Front Desk to see if Mark can come to the clinic another time, and hears back that he works full-time during the week and is insistent on speaking to a nurse today. After having sketched out a rough decision to deny the request, the nurse prepares a list of alternative locations the patient might try to request his medication as she calls him in. In their consultation the nurse then offers to call the ER that treated Mark and see if they will refill the medication, with the stipulation that Mark make an appointment to be seen at the clinic. She then scans the ER discharge forms and the medication brought in by the patient that she references later when contacting the ER.

This example of clinical problem solving highlights how triage decisions can be reached by a gap-closing negotiation of a treatment plan that meets the patient's needs with the clinic's capabilities. Again, Mark's request for a refill on a medication falls under the general capabilities of the clinic. However refilling his medication under clinic policy would require him to see a provider, and given the lack to physician resources available, Janice proposes postponing this to another day when physician resources may be freer. After Mark refuses this suggestion through the front desk staff, she calls him in and they arrive at a partial solution. Janice will contact the ER and request a refill on the medication until Mark's appointment, which serves as evidence of scheduled follow-up care. This compromise is an example of gap-closing problem solving: the treatment plan does not completely satisfy the patient's request but puts them in a position where the ER can satisfy their request. Janice leverages the ER's reluctance to incur another ER visit, one of Mark's alternative options, and the evidence of follow up care as a way to encourage this decision by the ER. Further, if the ER denies the refill, Mark still has a scheduled appointment soon where his

request can be dealt with. Drawing on her knowledge of clinical policy and incorporating the ER's history and prescription capabilities into the treatment plan, she develops a solution stays within clinic policy and satisfies the patient without using a provider's time.

TRiage AS A COGNITIVE PROCESS

Viewing the triage function of the clinic as cognitive allows us to see how triage decisions are accomplished by "the propagation of representational states" of the patient's need and the clinic's capacity. The analysis above has identified configurations of these media: clinicians, the triage slip, the EMR system, and other technology, as cognitive processes that are involved in carrying out triage function. Making explicit this flow of information through the clinic allows us to see how it is embedded in and shaped by the social and technical organization of the clinic. The following sections examine these aspects of the clinic's culture and how they influence the clinic's proposed redesign of the triage process.

The Socio-Technical Organization of the Clinic

The social organization of the clinic refers to the structured relationships that members of the clinic have with each other. The primary distinction between individuals pertains to their medical training and professional license, which corresponds to status, legal authority, and also a division of labor. Medical Doctors and Nurse Practitioners, termed "providers", have at least 6-8 years of education and are responsible for providing and managing care for patients through diagnosing and treating their conditions. Registered Nurses can have 2-4 years of education, and are responsible for assisting providers by consulting with patients to manage their conditions and incorporate providers' advice into their lifestyle. In a supportive position, their time flexible but is often under high demand from triage requests, follow-up care, and requests from other clinicians. Medical Assistants (MAs) can have as little as 6 months of training and are unlicensed support staff. Most MAs are assigned to work with specific providers, and are responsible for managing the routine processes of preparing patients to see them and following up with their instructions. Front Desk staff have no required medical training and are responsible for checking in patients, gathering and processing their demographic information, and scheduling appointments. They mediate communication between patients and the back office and also help with administrative and billing work. In addition to this formal medical hierarchy, members of the clinic have varying amounts of clinic experience including their knowledge of patients and local clinic practices.

The technical organization of the clinic refers to the information systems and artifacts that contain information about patients, are used in care delivery, and pertain to the operational procedures of the clinic. The EMR plays a crucial role in coordinating the work at the clinic, providing

both a centralized digital database of patient medical records and a clinical management system for scheduling appointments and coordinating care. Despite the digitization of the paper records at the clinic, paper documents remain an integral part of the clinic's workflow as constituents of operational procedure such as the triage slip, "transitional artifacts" such as sticky notes, and as mobile resources for both clinicians and patients. A major limitation of the EMR system is that it only contains a history of patient's interaction at the clinic. Information from other health care encounters at hospitals or with specialists can be transferred to the clinic digitally, but often needs to be sent by mail, faxed, or brought in by the patient and scanned. This is troublesome when patients like Mark show up at the clinic having received information or treatment elsewhere and clinicians are unable to access a record of their treatment.

This hints at a broader issue in information and knowledge management systems: most information is not sufficient by itself and must be contextualized to be of any use (Ackerman 1998). The technologies at the clinic are embedded in its social practices and are given meaning by them; they have powerful capabilities but also constrain what kinds of information can be captured and how they are represented. The EMR is a crucial part of the clinic's organizational memory that consolidates a wealth of documented clinical interactions, but it alone does not solve the problem of placing patient's condition in context. Clinicians must navigate and interpret the EMR to actively reconstruct what was done, by whom, and why. This process involves inferences based off of clinical practices of operation and documentation that come with varying degrees of uncertainty. In Teresa's case, the nurse's recognition of this uncertainty led to an initially conservative decision to deny her refill.

Flow of Information in Triage

Triage is situated in this complex socio-technical organization, which shapes the flow of information in making triage decisions. With flexible time and the authority to evaluate patients, nurses are given the responsibility of dealing with the unpredictable requests of triage patients and determining which patients can be given care and which can not. Patients' initial interaction with the front desk staff is largely related to determining whether or not they have scheduled appointments and if not, whether they meet the triage criteria. Once this determination has been made, the front desk provides the triage slip to the patient and sends it back to the nurse once it is filled out. This simplified representation of the patient's request fits the nurse's unstructured work schedule and removes her from having to directly interact with patients. Specific information is decoupled from the patient and provided in a structured format such that the nurses can deal with it on their own time. Nurses then interpret the request in context of the information available to them from their personal

experience and in the EMR, making use of their clinical professional vision. Reconstructing clinical history: who did what, when, and why, which requires making inferences about the information not documented in the EMR. The stable conventions and practices of the clinic provide a resource for making these inferences, but they are nonetheless uncertain and may conflict with the patient's testimony.

This organization of triage puts nurses in a grey area of expertise and accountability. Without the training and license of providers, they are not able to authoritatively diagnose and treat patients. However they invariably encounter patients with sparse information and uncertain conditions where clinic policies are not clearly defined, and where decisions must be made about if and how to provide care. These decisions must be documented and recorded: those reviewing the history of a patient will be able to see what they did, often with little information about why³. Thus nurses must make decisions where they have little familiarity with patients' histories and their providers' care plans with the looming knowledge of accountability. In these situations nurses utilize various resources to meet patients' needs, and also have the option to consult with other nurses, MAs, or providers for advice. In both Teresa's and Mark's cases, Janice consulted with a provider at the clinic and the ER, which quickly both clarified the decision and shifted accountability away from her. However, because the purpose of triage is to minimize impact on providers' highly valued and structured time, these consultations are rare.

Organizational Adaptation of Triage

The implementation of policies in the Affordable Care Act (ACA) in 2014 increased the accessibility of insurance to low-income individuals. This institutional change has encouraged more people to come to the clinic for both scheduled and unscheduled care. By the clinic's own estimate, the average number of patients needing to be triaged has doubled from 20 to 40 per day. At the time of the study, this increased load on the system occupied much of the nurse's time, preventing them from doing other tasks such as managing the care of chronic disease patients. This time spent triaging is also largely unbilled, which means the clinic is losing money by paying nurses to provide a free service. Evaluating patients and having them see providers at times also impacts the rest of the schedule for the day, which means patients who show up to scheduled appointments have increased wait times. This increase in workload negatively affects the morale of the staff, and strains the social relationships between nurses, staff, and the front desk. As noted in an interview with the Director of

³ In these situations, nurses often document much more than they would otherwise, attempting to capture enough context to justify their decisions.

Nursing at the clinic, many factors related to the high load triage are more systemic issues regarding the socioeconomic setting of the community, the high numbers of individuals with chronic diseases, the wide-ranging types of insurance that the clinic accepts, and the lack of providers who want to work at a community clinic. She further explained the clinic's efforts to adapt by reorganizing the triage process to distribute the load of triage away from the nurses by encouraging a greater filtering role of the front desk staff.

A follow-up interview with nurses at the clinic a few months after the study seemed to indicate positive results of this organizational change. The adult care building's front desk now actively manages the daily schedule, monitoring patients who don't show up for appointments or show up without appointments. The clinic's administration, after discussing with providers, nurses, medical assistants, and front desk staff, established this new role at the front desk as a centralized check-in for the entire clinic. Additionally, this reorganization has brought a more granular level of filtering to the triage process. Patients whose request is largely administrative or logistic, such as registering at the clinic or updating information, are now dealt with exclusively by a dedicated staff member at the front desk. These tasks had been previously been dealt with informally by medical assistants, nurses, and front desk staff. By establishing explicit parameters for filtering triage patients, the front desk now makes decisions about which patients have logistical issues they can address and which patients have medical concerns that need the attention of a nurse. One of the nurses remarked that this new workflow was much better, as it reduced the number of triage cases she had to deal with and allowed her the flexibility to attend to immediate concerns. Redistributing the work in this way increased the filtering capabilities of the front desk, increasing their workload but focusing the triage process on urgent medical cases. This organizational adaptation seems to have reduced the load on nurses and aligned the work of the clinic with the training and expertise of its staff.

CONCLUSION

Triage at the clinic is an example of a cognitive function that occurs through the "propagation of representational states across multiple media" (Hutchins 1995). Configurations of these media, whether they are clinicians or technology, can be seen as cognitive processes assembled by the clinic in the production of triage decisions. The classification of patients by the front desk and the simplification of their representation through the production of a triage slip is a form of attention. The subsequent assessment of a patient's request in the context of their clinical history as documented in the EMR is a form of memory & interpretation. Finally, the evaluation of clinical constraints and treatment options by clinicians are forms of decision-making and problem solving. These processes, commonly associated with individual cognitive

function, are thus also performed by the clinical activity system.

The organization of these configurations and the flow of information through the activity system is situated in and shaped by the complex social and technical organization of the clinic. Nurses, with intermediate levels of medical expertise and authority, are primarily responsible for making triage decisions. Their ability to evaluate patients' immediate requests also depends on their interpretation of the documentation in the EMR system. In these often-uncertain situations, nurses make use of a variety of clinical resources to meet patients' needs. Further, the socio-technical organization of this system local to the clinic is also influenced by much larger cultural changes in health care including the digitization of medical records and governmental policies increasing access to insurance.

Such changes have tangible impacts on the ways that health care is practiced in such real-world settings. The clinic's reorganization of their triage process to distribute an unnecessary administrative triage load away from nurses is an example of an organizational response to one such change. While this change seems to have had a positive impact on the work of nurses, it also serves as a reminder that the implementation of broader changes in healthcare requires the local socio-technical adaptation of health care settings. With health care in flux, we hope to add to an understanding of how decision-making is performed in clinical settings, with the reminder that such processes are situated in complex cognitive ecosystems.

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REFERENCES

1. Ackerman, M. S., Halverson, C. "Considering an organization's memory." Proceedings of the 1998 ACM conference on Computer supported cooperative work. (1998): 39-48
2. Chen, Y. "Documenting Transitional Information in EMR." CHI 2010 (2010): 1787-1796.
3. Fouse, A., Weibel, N., Hutchins, E., Hollan, J.D., "ChronoViz: a system for supporting navigation of time-

- coded data.” CHI '11 Extended Abstracts on Human Factors in Computing Systems (2011): 299-304
4. Franklin, A., Liu, Y., Li, Z., Nguyen, V., Johnson, T.R., Robinson, D. Okafor, N., King, B., Patel, V.L., Zhang, J. "Opportunistic Decision Making and Complexity in Emergency Care." *Journal of Biomedical Informatics* 44.3 (2011): 469-76.
 5. Goodwin, C. "Professional Vision." *American Anthropologist* 96.3 (1994): 606-33.
 6. Hazlehurst, B., Gorman P.N., McMullen C.K. "Distributed Cognition: An Alternative Model of Cognition for Medical Informatics." *International Journal of Medical Informatics* 77.4 (2008): 226-34.
 7. Heath, C., Luff, P., and Svensson, M. S. "Technology and Medical Practice", *Sociology of Health & Illness* Vol. 25 Silver Anniversary Issue 2003. (2003): 75-96
 8. Health Information Technology for Economic and Clinical Health (HITECH) Act, Title XIII of Division A and Title IV of Division B of the American Recovery and Reinvestment Act of 2009 (ARRA), Pub. L. No. 111-5, 123 Stat. 226 (2009)
 9. Hollan, J.D., Hutchins, E. "Opportunities and Challenges for Augmented Environments: A Distributed Cognition Perspective." In Lahlou, S. (Ed.), *Designing User Friendly Augmented Work Environments: From Meeting Rooms to Digital Collaborative Spaces, Computer Supported Cooperative Work* (2009): 237-259.
 10. Hutchins, E. *Cognition in the Wild*. Cambridge, MA: MIT, 1995.
 11. Iserson, K. V., Moskop, J.C. "Triage in Medicine, Part I: Concept, History, and Types." *Annals of Emergency Medicine* (2007): 275-281
 12. Neisser, U. "Memory: What Are the Important Questions?" In Gruneberg, M.M., Morris, P.E., Sykes, R.N. (Eds.) *Practical Aspects of Memory*. (1978): 3-24
 13. Vinkhuyzen, E., Plurkowski, L. "Implementing EMRs: Learnings from a video ethnography." *EPIC 2012 Proceedings* (2010): 210-223.
 14. Williams, R. F. "Using Cognitive Ethnography to Study Instruction", *Proceedings of the 7th International Conference of the Learning Sciences*. (2006)