

# Fragmentation and Choreography: Caring for a Patient and a Chart during Childbirth

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## ABSTRACT

CSCW has long been concerned with how work is coordinated. A rich body of literature examines the mechanisms underlying cooperative work and the articulation of discrete tasks into meaningful sequences of action. However, there is less treatment of how workers balance multiple streams of work at once. In hospitals, the introduction of Health Information Technologies coupled with increased requirements for documentation means that workers must simultaneously care for and integrate two work trajectories: that related to the patient and that related to the medical record. Using data from an ethnographic study of labor & delivery nurses in a mid-size hospital, I describe the situated, embodied, and effortful work of coordinating multiple streams of action into a single coherent performance of work, a process I refer to as choreography, and present a number of choreography practices. I then describe implications of this perspective for CSCW.

## Author Keywords

Coordination; HIT; Documentation; Choreography.

## ACM Classification Keywords

H5.3 Computer Supported Cooperative Work: Miscellaneous.

## General Terms

Documentation; Design; Human Factors

## INTRODUCTION

The field of CSCW has long been concerned with coordination of work. This paper expands on previous conceptualizations of coordination by describing a new type of coordination work, which I refer to as choreography. Choreography is the embodied work of balancing and maintaining multiple simultaneous streams of work and

bringing them together into a single coherent stream of actions. I ground this theoretical proposition in ethnographic data focusing on how obstetrical nurses balance documentation work with patient care during childbirth.

This case provides an especially rich and timely context in which to examine choreography work. Documentation has long been a central feature of medical work [7,35]. Recently, documentation has been changing as an influx of Health Information Technologies (HITs) coupled with increasing regulation, legal pressure, and public demand for transparency and accountability of hospitals and medical providers has led to a profusion of documentation requirements [37]. The intensification of documentation requirements coupled with technological changes in the work system makes it increasingly difficult to balance and integrate documentation work with patient care.

This work contributes to CSCW and extends the literature on work coordination by describing choreography work. Work in general requires bringing multiple disparate tasks into a coherent sequence of actions. I analyze how nurses, through a variety of effortful embodied, social, and cognitive practices, choreograph the practice of documentation to manage competing work trajectories and goals. The rest of the paper is structured as follows; first, I ground my research in past CSCW studies on coordination. I then describe methods. In the finding section, I discuss the logics underlying the current documentation work system and describe how nurses engage in choreography practices both to produce a viable medical record and to integrate this documentation work with the work of caring for a patient during childbirth. I conclude by drawing out implications for CSCW research on supporting choreography of multiple work trajectories simultaneously.

## BACKGROUND

### Coordination in CSCW

Coordination is a central topic in CSCW research and a rich body of literature has contributed to our understanding of workplace coordination [see 14, 28, 29, 31 among many others]. Although coordination has been defined in multiple ways, three general postulates underlie research on workplace coordination: 1) people work collaboratively; 2) work is interdependent; and 3) this interdependent work is

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in the service of some particular goal or piece of work [25]. Schmidt [30] proposes a distinction between cooperative work and articulation work. The term cooperative work describes the technical (causal, temporal, and logical) connections between interdependent tasks. In contrast, articulation work as described by Strauss et al. [31] is the second-order work of coordinating and integrating tasks and clusters of tasks together in a meaningful way that will accomplish the intended goal. A number of mechanisms, or organizational arrangements that facilitate a collaborative performance [25], have been identified. These include routines [16, 17]; boundary objects [29]; and co-location [1], among others.

An important concept for the present research drawn from medical sociology [30] is that of “trajectories.” Strauss uses the term trajectory to describe the physiological unfolding of a disease process along with the entire organization of work done over the course of a disease process and the impact on the people doing this work. Over the course of a single trajectory countless routines, artifacts, and rules are articulated in order to provide a course of treatment for a single patient. Therefore, the notion of trajectories provides a useful way for talking about the entirety of the coordination efforts and mechanisms that come into play in service of a collective piece of work.

#### **Situated and Agentic Coordination**

A pivotal development in research on coordination is the emergence of a perspective that focuses on the situated, emergent, and effortful nature of coordination [see for example 16, 20, 28, 33]. Suchman [33] makes the point that action is necessarily situated and improvisatory; people often have a plan in mind of how to act but the plan is constantly re-adjusted based on the specifics of the situation at hand and the embodied skills and knowledge available to a person in a situation. In the medical world, articulation work involves maintaining control of a disease trajectory by both coordinating work along expected paths associated with a condition and also re-articulating as problems and interferences arise [30]. Another important contribution in understanding coordination is Feldman’s [16] work on the performative aspect of coordinating. Focusing on routines as a coordination mechanism, Feldman demonstrates how people performing routines change courses of action through processes of ongoing reflection. The thoughts, feelings, and actions of people are resources that shape the performance of coordinated work on an ongoing basis.

#### **Coordination and Multi-tasking**

A rich body of work describes the mechanisms through which work is coordinated and the emergent, situated, and agentic nature of coordination work. However, much research up to this point has focused on how work is coordinated to pursue a single work trajectory; for instance, the complex articulation work required to collectively perform activities such as auditing an accounting invoice [32], driving a train [15], or caring for a patient with lupus

[30]. A more recent body of literature examines the problem of work fragmentation, defined as “a break in continuous work activity” [22] and the ways in which information workers multi-task to accomplish multiple streams of action [19]. These studies, however, focus on characterizing the nature and frequency of interruptions and describing how people use information technologies to maintain continuity in multiple tasks. The present study draws on Suchman’s [33] work on situated action and Feldman’s [16] work on the role of agency in coordination. In contrast to previous studies on multi-tasking described above, the present study focuses on *choreography*, or the embodied, social, and cognitive practices of carrying out a situated and improvisatory performance that involves multiple trajectories of work.

#### **METHODS**

I used ethnographic methods consisting of observation and interviews with informants. A qualitative methodology is appropriate since the objective was to examine in intricate detail what people were actually doing and thinking, processes not readily apparent through other methods [11]. The Labor & Delivery (L&D) unit of H1 has 14 beds and approximately 55 nurses who work 12 hour shifts from 7AM to 7PM. About 1,000 deliveries per year occur in H1. H1 is well-equipped to handle both very high risk pregnancies and sick and premature infants, so the unit sees an exceptionally large number of high-risk cases.

I conducted observations in the L&D unit of H1 for 16 months for periods of time ranging from four to fourteen hours during all times of the day as well as at night. Observations took place once or twice per week, intersected by three four-week periods away from the field in order to reflect and analyze data. I also conducted observations of unit and hospital-wide staff meetings, daily rounds, Practice Council, grand rounds, computer documentation training sessions, and various other education and training activities. Field notes were recorded using pen and paper and typed after leaving the field in the manner described by Emerson, Fretz, & Shaw [13].

My informants include bedside nurses, charge nurses, nurse managers, and several other interdisciplinary personnel. I focused on the practices of nurses in relation to the larger context of the obstetrical team. I also conducted a focus group interview with twelve L&D nurses and nine formal semi-structured interviews with L&D bedside nurses, as well as interviews with nurse managers and others who work in or collaborate with L&D (see table 1 for a description of data collected).

I analyzed data using a set of steps outlined in grounded theory [11]. In grounded theory, data collection, data analysis, and theorizing occur continuously, and each activity overlaps and informs the others. One of the hallmarks of this approach is that as soon as researchers begin to tentatively form categories in the data, a process of constant comparison begins and all new pieces of

information are held up against those that already populate the category; in this way, the researcher is pushed to challenge and refine their description of the phenomenon. Additionally, I used data analysis to guide future data collection as analysis pointed me towards categories and properties that required further development and explication [11]. Essentially, I used a process of reading through my interviews line by line performing open coding, then organized these codes into categories and went through my data again, coding according to the categories I had developed. During this process, I wrote extensive memos about key themes I saw emerging from the data, which I later refined through the process of writing. During data analysis, I presented my findings to participants, including the nurse manager and bedside nurses, in a series of informal conversations to contest findings and clarify pre-conceptions [21].

*Observations.* Observations were conducted in the labor & delivery unit of H1. Individual nurses were shadowed as they went about their work. The researcher observed all aspects of care, from triage through delivery (in a delivery room for vaginal births and in an operating room for surgical births).

*Informal conversations.* The researcher engaged in countless informal conversations with participants in H1 during fieldwork. These included conversations with nurses, nurse managers, residents, unit secretaries, scrub techs, anesthesiologists, quality analysts, nurse informatics workers, and others.

*Interviews.* Individual semi-structured interviews and focus groups of labor & delivery nurses were conducted with participants both from H1 and from a number of surrounding hospitals (conducted as part of preliminary field work).

H1: L&D RN's (9) nurse managers (2) perinatal educator (1) medical students (4) resident (1) blood bank personnel (1) perinatal coordinators (2) focus group of L&D nurses and nurse managers (12 participants)

Preliminary interviews conducted with participants outside H1: L&D RN's (6) physicians (3) nurse managers (3) nursing directors (3) certified nurse-midwives (2) public health official (1) focus group with L&D nurses and nurse managers (10 participants).

**Table 1: sources of data**

**FINDINGS**

I will first provide an overview of the two work trajectories the nurses manage, the patient work and the documentation work. I then describe several choreography practices that nurses engage to integrate these two streams of work into a single coherent flow of actions.

**Caring for a Patient**

L&D nursing presents a unique situation where patients are (for the most part) healthy people doing something that is, while potentially risky, very personal and meaningful. Additionally, L&D nursing work is unique in some other important ways: 1) while patients across the hospital are enrolled in various kinds of work related to their care [30], L&D patients are required, by the nature of the task, to take on a much more significant role as “workers” than in most

units. Consequently, duties placed on L&D nurses as manager and coach are also greater than those of other types of nurses. 2) L&D seems to generally have higher requirements for documentation than other units, at H1 and otherwise. Explanations given by hospital workers for this center on the fact that obstetrics is a highly litigious specialty where malpractice verdicts frequently favor families and the unique patient situation, described next. 3) L&D nurses are in the unusual situation of having a “two patient problem;” they must care for two patients but one (the baby) is only visualizable, and thus nurse- and doctorable, through the use of an assemblage of technologies. All nurses must balance documentation with patient care; this is a commonality of hospital work. However, the qualities outlined above may exacerbate the tension between documentation work and patient work in L&D, particularly during the intense pushing phase and the birth itself.

Each patient is assigned a primary nurse. Nurses conduct continuous close observation of mother and baby, looking for potential signs of distress. This nurse is also responsible for performing various procedures, assisting physicians, and administering medications, among other tasks. The primary nurse is a “hub” who serves as the main source of communication between the patient and the team; nurses coordinate the actions of residents, anesthesiologists, assistant nurses, pediatricians, scrub techs, and so on to ensure that the necessary people and equipment are in the right place at the right time as a labor progresses. An important part of L&D nursing and an ethos of nursing care in general is to maintain physical presence and connection with patients [10]. As one nurse described it, she strives to “...be the eyes that my patient sees and the voice that my patient hears.” This becomes particularly important as a labor progresses and a patient starts pushing. The primary nurse engages in intensive coaching, encouragement, and physical support as she “pushes with” a patient.

Typically, two to three nurses come to the room to assist the primary nurse during a vaginal birth. Support nurses help in a variety of ways. During a vaginal birth, there is a lot of talking and cheerleading during pushing (‘c’mon, c’mon, almost there, little more!’). The primary nurse heads up this effort, with other nurses forming a supportive chorus. Nurses also physically hold and support the patient. During a contraction, a nurse on either side will hold one of the patient’s feet in her hands and wrap her other arm around the patient’s bent leg, forming a human structure the woman braces herself against as she pushes. Nurses outside the room, including the charge nurse, also coordinate with nurses in the room to assist with work in a variety of ways.

**Caring for a Medical Record**

**Accountability and Health Information Technologies**

“We will make sure that every doctor’s office and hospital in this country is using cutting edge technology and electronic medical records so that we can cut red tape,

prevent medical mistakes, and help save billions of dollars each year.” -President Barack Obama, 12/6/2008

The practice of documentation in hospitals is enmeshed in the social and political landscape of medicine. In the past 20 years concern has grown that hospitals are sacrificing quality in the name of cost containment, leading to the emergence of an accountability imperative in the medical field [37]. Patient-consumers and third-party buyers of healthcare along with regulatory agencies are now demanding an unprecedented degree of transparency and accountability [35]. The accountability endeavor is in large part contingent on what has been called the “next major change” in medical record keeping practices [26], the shift away from paper-based records and toward computerized records [35]. Implementing HITs for documentation has been advanced as a key to improving health care. HITs are expected to increase efficiency and safety of care as well as provide a multitude of other benefits [2]. Despite skepticism from the medical community and studies showing mixed results from HIT implementation [3], adoption of HITs, particularly Electronic Medical Record (EMR) programs, has escalated and is expected to increase as the government is now offering major incentives to hospitals for purchasing EMR systems [18]. With this in mind, I will now describe the documentation work that takes place in the L&D unit of H1.

### Documentation in H1

The documentation work system in H1’s L&D is highly fragmented. Multiple computer- and paper-based artifacts are used by the nurses, and these artifacts exist in multiple sites in the physical and information workspace. This infrastructure has accrued in layers over a period of decades. Nurses must “care” and tend to the medical record and the assemblage of documentation technologies just as they must care for and tend to patients.

The most important part of the documentation work system for the L&D nurses is a computer flowsheet program (quantitative sentinel or “QS”) that nurses use to chart throughout a birth. A key feature of QS and the reason it is so important is that it is linked with the electronic fetal monitor (QS thus ties back in with the “two-patient problem” described above). Nurses watch the pattern created by the fetal heart rate (called the “strip”) and contractions over time and make notations at regular intervals as well as noting any aberrations; this gives the team information about how the baby is coping with the labor process and whether intervention is needed. The strip is also used as a marker of time. Nurses click on the strip to open the flowsheet and chart on what is happening at any specific moment, often on a minute-by-minute basis. The flowsheet thus provides a “blow-by-blow” account of what is happening during a birth.

H1 uses two additional computer programs for documentation, a new electronic medical record implemented in 2010 (“Quest”) and the older linked

program Quest is intended to replace (“TDS”), implemented in 1990. QS and Quest cannot be interfaced due to cost and technical issues. Therefore, nurses must log in and navigate between two separate computer programs to complete documentation in each; for a variety of reasons, nurses must often move between workstations and locations to access each of the programs. Although many functions were migrated to Quest from TDS, a few tasks continue to be performed using TDS (see table 2). Finally, the unit continues to maintain a paper chart for each patient. The paper chart contains a multitude of forms that must be completed for each patient. One form of particular importance during a birth is the L&D Record, a tri-fold sheet filled out gradually over the course of the labor and typically set out on a wheeled table in the hallway outside the patient’s room during the birth.

Clearly, the documentation work system is quite complex. One of the most frequent complaints from nurses is that they chart the same piece of information over and over. For example, if a patient is given pitocin (a drug used at some point in almost all births that stimulates uterine contractions), the nurse must complete documentation in the pyxis (medication room computer system), type a series of notes in the QS flowsheet on pitocin administration, complete documentation in another section of QS that tracks fluid given from each IV bag, complete a series of documentation tasks in Quest related to carrying out medication orders, and note on the L&D record and the QS delivery summary that labor was augmented with pitocin.

Documentation is time-sensitive and limited by the cognitive capabilities of humans to remember information—some pieces of information will be lost if they are not recorded somewhere (even if somewhere is a paper towel, a random piece of paper, or on one’s scrubs) at the time they occur. Additionally, if nurses do not keep up with charting, there is a feeling of being “buried” under it—nurses do not want to let too many documentation tasks accrue or they will have difficulty remembering what needs to be charted where and when. Nurses have different tolerances for letting documentation work pile up without feeling overwhelmed, but documentation in general is not a kind of work that can be “put down” for any length of time; the medical record must be attended to just as the patient must be attended to. The larger legal, political, and organizational context surrounding medical work has placed increasing emphasis on completeness and rigor of documentation. The fragmentation of charting tasks means that documentation requires elaborate situated coordination in order to keep up and produce a healthy medical record. Each component of the chart serves a purpose with regard to accountability, which I will describe next.

### Accountability logics

Different pieces of the medical record serve different accountability functions (see table 2 for a brief overview of the function and logic associated with key documentation

artifacts). The computerized flowsheet is a key piece of evidence in legal cases. Providers refer to this as cover-your-ass (“CYA”) charting. The flowsheet also serves professional interests, as it demonstrates work done by the nurses and serves as a source of legitimation. When a bad outcome, an error, or a near-miss occurs, these pieces of the chart are reviewed during debriefs, rounds, and practice council meetings.

Form	Function	Logic
Labor & Delivery Record (Paper)	Summary of key information from a delivery. Quality analyst extracts data for statistics reported to various regulatory/QI agencies.	Regulatory accountability
Flowsheet (QS)	Ongoing record of patient data, aberrations, actions taken. Linked with fetal monitor.	Legal & Professional accountability
Delivery summary (QS)	Summary of key information from a delivery. Physicians use for statistics.	Inter-organizational accountability
Patient Outcome Plan (TDS)	Plan for addressing psycho-social problems identified by the nurse, required by CMS.	Regulatory Accountability
Orders, worklist (Quest)	Notes on completed orders, nurses charge patients for supplies, medications, and procedures.	Fiscal & Regulatory accountability

**Table 2: Function and logic associated with some of the documentation forms used in L&D**

Other pieces of the chart satisfy accountability requirements from regulatory agencies, accreditation organizations, and consumer advocacy organizations who make the results publicly available. For example, the quality analyst uses the L&D Record to extract statistics for a database of information reported to the state public health department. The new EMR system, Quest, is designed to adhere to best practices for patient safety including extensive documentation intended to prevent medication errors. Quest is also the primary site for fiscal accountability, where nurses enter charges for equipment, medications, and procedures.

**Choreographing Patient and Chart**

I now turn my attention to the integration of the two fragmented trajectories of work, caring for the patient and caring for the medical record. I begin with an ethnographic vignette to illustrate a typical scene during a birth; using this vignette along with additional examples, I then describe a set of *choreography practices* that nurses engage in to integrate the trajectories into one coherent flow of actions.

2:15 PM

The nurse is adjusting the monitor machine, turning a knob that makes the blood pressure cuff contract- she wants to keep an eye on the pressures. Then she moves her hands up and fiddles with the computer monitor- the computer screen went off for some reason, so she gets it back on. On the screen, the line of the tocometer, which measures contractions, is going up- the patient is having a contraction.

“Here we go!” The nurse calls, and moves quickly back to the bed, taking the patient’s left foot in her right hand. “ready? push!” Her other hand is pressing down on the fetal monitor so the baby’s heart rate won’t be lost during the contraction. A second nurse, who had been prepping a label for a sample, puts down her work and moves to the patient’s other side, mirroring the first nurse’s pose. The resident sits on the end of the bed, feeling for the baby’s head in the birth canal as the patient pushes. Meanwhile, the nurse is counting slowly to ten while the patient pushes, her face tight with strain. Through the contraction, the nurse continuously coaches, holds the leg, and works the monitor with her left hand to keep the baby’s heart rate visible on the screen. The second nurse leans over the watch the perineum as the patient pushes and gives further direction as the first nurse counts- “that’s it, strong strong strong- push in your bottom. No, don’t make noise! Save it for pushing. Good!” As the contraction fades, the first nurse releases her grip. She looks at the resident: stop the pit? Resident: yeah, please.

2:16 PM

The nurse talks out loud to herself- ‘oxygen going, pit stopped, patient repositioned...’ as she pivots to the IV pump, quickly navigating a series of screens to stop one medication and change the volume on another. She then takes two quick steps to the computer, clicks on the strip and opens the flowsheet, clicking rapidly through several screens to get to a screen for general comments where she quickly types ‘pit stopped, bolus started, O2 given, pt. repositioned...’ The patient has her eyes closed on the bed, head turned to the side, husband standing next to her looking a little lost. ‘Keep breathing...’ the nurse says, her eyes on the screen. Meanwhile, in the hallway, a paper form sits open on a table. Another nurse stops by to see what’s happening. On her way out she stops at the table, picks up a pen, checks a box, then moves on.

2:18 PM

The first nurse, at the computer in the room, clicks on the fetal monitor strip to enlarge it just as another contraction starts to build. She turns away from the computer, back to the bed and gets in position for another push...

**Choreography Practices**

Research on coordination typically considers how workers collectively execute a single work trajectory. However, L&D nurses are managing two work trajectories- a patient trajectory and a documentation trajectory. Each trajectory involves divergent work routines and skillful care. Nurses engage in *choreography practices* to connect the two trajectories together into one coherent workflow, including:

**Moving**

Choreography requires more than mentally balancing tasks; the choreography work of L&D nurses is very physical, and physically demanding. Nurses change the position of their body, hands, and eyes as they engage with and transition between different tasks. Movements are both small

(moving hands, glancing) and large (pivoting, stepping, power walking) as nurses travel between the patient and the different sites of work- the computer, the IV pump, the table in the hallway, the medication room down the hall.

### **Synching**

Nurses must synch charting work with the events that are unfolding with the birth and with the other providers. The nurse in the vignette engages in a common synching strategy by pushing with the patient during contractions and charting on the computer (as well as completing a multitude of other tasks) in the few minutes between contractions. It is almost as if the nurse is present during a contraction and then disappears between contractions, as she has space to attend to documentation tasks. If a nurse attempts too much in the space between contractions, she will lose track of the patient. If she does not smoothly transition away from the patient when there is a rest, she will lose track of the chart. Nurses find, maintain, and adjust a rhythm during each birth.

### **Juggling**

Juggling involves choreography to handle multiple tasks at once, keeping an eye on different tasks simultaneously. A nurse's eyes and hands are divided between multiple sites of work. Between contractions, nurses do the supportive work of caring for a patient- coaching ("keep breathing"), encouraging ('you're doing great'), answering questions (yes the epidural is working, but you feel pressure as the baby comes down)- while standing at the computer clicking through boxes and typing notes on whatever just happened ('pit stopped...'). The nurse's focus on the computer screen and keyboard is punctuated by glances at the patient, but the nurse types about one thing and talks about another at the same time or in close rapid succession.

### **Prepping**

Nurses prep constantly. On an ongoing basis, nurses attempt to anticipate their own future documentation and patient care tasks and the tasks of others and ready things so they can be completed with fewer steps later on, smoothing out their path so they can flow more easily through and between tasks seconds, minutes, or hours in the future. For example, if a nurse knows she will need to chart on a patient's vital signs, she opens the computer flowsheet to the first screen of a series of screens involved in charting vital signs, then goes to check the patient's vitals so she can enter the vitals a few minutes later without logging in.

### **Collaborating**

Choreographing documentation involves skillful teamwork. Multiple nurses coordinate their actions to care for the chart. At some point during a birth, the physical work of delivering a baby becomes so intense that the primary nurse has to stop tending to documentation all together. Helping a patient to push involves holding legs back and up, manipulating the fetal monitor and watching the strip on the screen, and coaching the patient while she pushes. When

this work becomes too consuming and the nurse can no longer make it back to the computer between contractions, another nurse moves to the computer and picks up the charting, recording the "blow by blow" on the computer flowsheet. In many cases, a third nurse tends to the L&D Record and the rest of the paper chart, looking around the curtain to watch the action and fill out the record while doing other small tasks like preparing containers and labels for specimens, getting ID bracelets ready, and manning the phone. This collaborative choreography occurs wordlessly- monitoring the chart, in its different locations, is something all of the nurses keep an eye on.

### **Triaging**

Nurses engage in a cognitive process in order to maintain and integrate dual trajectories. This process involves constant attention- or at least partial attention- to the tasks at hand and ongoing, moment to moment decisions about what needs to be done next:

"You really have to be able to know how to multi-task and know how to prioritize what you're going to be doing at every minute, basically..." -RN, L&D

During intensive phases of birth, nurses may have many tasks related to both documentation and the patient. At any given time, they have to assess all of the things that need to be done and make decisions about what needs their attention most, how they will fit in the urgent but slightly less pressing tasks, and what can be left for later. Nurses also engage in cognitive work to keep information straight- the nurse in the vignette talks out loud to herself, repeating the things that need to be charted as she walks to the computer.

## **DISCUSSION**

### **Choreography**

"In dance, choreography is also known as dance composition. Dance compositions are created by applying one or both of these fundamental choreographic techniques:

**Improvisation**, in which a choreographer provides dancers with a score (i.e., generalized directives) that serves as guidelines for improvised movement and form...

**Planned choreography**, in which a choreographer dictates motion and form in detail, leaving little or no opportunity for the dancer to exercise personal interpretation."

-Wikipedia.com entry for "choreography"

Nurses work individually and collectively to choreograph the actions of two competing trajectories into one coherent flow of actions through a variety of practices, described above. I do not use the term "choreography" in the sense of a highly choreographed ballet that is planned and rehearsed before a performance. Instead, I initially borrowed the term from William Whyte [36], who studied the life of city streets. Using time-lapse video, Whyte showed how people walking across a crowded plaza choreograph their movements. The ease with which people are able to move

purposefully across a busy place without ever colliding is surprising and, he argues, requires a high degree of skill; the success of a plaza's design is reflected in the degree to which it supports its occupants in the service of this choreography. Similarly, nurses have directives about what needs to be done, along with a set and props on which to carry out their work. Choreography is emergent as the nurses perform and transition between tasks, creating a single flow of actions. This is consistent with a situated action perspective: "...the organization of situated action is an emergent property of moment-by-moment interactions between actors, and between actors and the environments of their actions...the emergent properties of action mean that it is not predetermined, but neither is it random" [33:179].

However, Whyte's notion of choreography does not adequately describe the coordination work of L&D nurses. Dancers in a ballet and commuters walking through a plaza have a distinct advantage over L&D nurses. Each group has a single overarching goal: perform a ballet, get to the other side without bumping into anyone. The notion of choreography in the hospital is further complicated as it becomes clear that nurses are actually engaging in two simultaneous performances: caring for a patient dyad in order to produce a healthy mom and a healthy baby and documenting their actions in order to produce a viable account that will stand up to all of the rigors it may be subjected to. Here's how one nurse described charting:

"It's just constantly writing what you've been doing so that if you ever have to go back... if you're writing every single thing down, they'll be able to say, 'Okay, you were doing this at 10:31 in the morning and then this happened at 10:33...'and...If you didn't write it down, then you didn't do it. That's what they always say. Even if you really did do it (laughs)." -RN, L&D

So nurses do work and then document that they did work. In the view of the organization, one of these kinds of work does not exist without the other. When considering the embodied practice of the nurses, however, these tasks are quite different. Taken separately, each could occupy almost all of the time and attention of one worker (recent reports in the media of a newly emerging role for medical "scribes" who follow physicians and complete documentation attest to this), yet nurses must find a way to accomplish both. An apt metaphor can be drawn from the book *Harry Potter and the Prisoner of Azkaban*, in which over-achiever Hermione secures a magical device called a time-turner so she can literally be in two different classes at once<sup>1</sup>. During intense phases of work, L&D nurses are essentially attempting to do something similar, but without magical aid. Instead,

<sup>1</sup> Thanks to Martha Feldman for suggesting this metaphor. It is worth noting that at the end of the book, Hermione cedes the time turner, saying "I can't stand another year like this one. That Time-Turner, it was driving me mad. I've handed it in."

they regularly engage in a series of choreography practices to bring the patient work and the documentation work together. These practices are highly physical, and often physically demanding. Choreographing patient and chart involves movement, tempo, and rhythm and necessitates ongoing collaboration and attention, resulting in a single improvisational performance.

### Skillful Choreography

Benner, Tanner, and Chesla [4] describe how nurses go from novice to expert. Much of clinical expertise, they argue, is more embodied, engaged and practical than it is typically depicted in rational technical models of decision making. Similarly, skill in choreography requires an artfulness that develops over time. Part of becoming an expert nurse is becoming familiar with the artifacts-learning to properly complete a multitude of forms and quickly navigate the computer systems involved in documentation. This set of skills becomes especially apparent when a nurse is away from the hospital for a period and then comes back to practice. One nurse re-orienting in L&D after three years working as a research nurse told me:

'My skills just aren't there right now. It's not the medical stuff, it's all of this [indicates the computer], the computer and the documentation.' -RN, L&D

Expertise extends beyond how to simply complete different tasks, however; nurses also learn to transition gracefully between tasks and perform a cohesive dance given multiple competing directives. This becomes apparent as we examine another dimension of skillful nurse choreography. Just as one of the rules of Hermione's time-turner was that no one could find out she was in two places at once, nurses attempt to choreograph their work in a way that keeps charting invisible to patients:

"I try not to make my patient feel that that's my primary task. That should be, kind of, behind the scenes. And it's...it's an art. And I'm still learning how to do it best." -RN, L&D

To better understand this, I turn to a discussion of the intersections between care, documentation, and the professional identity of nurses.

### Caring, Documentation, and Identity

Nurses have a unique professional identity. They are highly trained, clinically skilled individuals who value caring for patients through intimate observation and connection [9]. It takes years of professional experience to develop nursing expertise [4]. None of the nurses I shadowed mentioned wanting to work with technology and computers as a reason they went into nursing. All cited a desire to take care of patients. Some were drawn to the idea of a collaborative work environment or particularly chose H1 because it is a teaching hospital where they can continually improve their clinical skills and contribute to training young providers.

Some are drawn to the challenge of taking care of very high-risk patients and the adrenaline rush of dealing with emerging crises. Many of the L&D nurses I spoke from mentioned that they derive a sense of honor from participating in an important moment in a family's life. Nurses derive satisfaction and identity from activities such as caring, doing skillful medical work, teaching, learning, dealing with crises, and witnessing important life events.

Most of the nurse participants in my study expressed frustration at the amount of work fragmentation they experience due to documentation. It is clear that although the nurses balance documentation and patient care, they ground their identity in only one of those tasks. Feldman [16] conducted her research on the crucial role of agency in the ongoing iteration of routines in the student housing unit of a university. She uses an example of a situation in which building directors alter a routine for moving out of the dorms because they feel the current routine does not allow them to perform their core duty as educators. Similarly, L&D nurses at H1 draw on their nursing identity as they attempt to choreograph a performance that foregrounds patient care and backgrounds documentation and computer work. For instance, by stepping in (and physically stepping up to the computer) to take over documentation in the moments before birth, nurses collaborate to create pockets of time and space in the stream of actions- like an eddy in a river- for the primary nurse to maintain a continuous presence at the bedside as birth becomes more intense.

Sometimes the nurses are unable to successfully produce a performance that satisfies all of the directives they are tasked with. Busy nurses engage in a near constant process of triaging, deciding what to do next and what to put off. Generally, nurses prefer to prioritize the patient whenever possible. However, nurses sometimes feel that if they privilege patient care over charting there will be sanctions:

'Some nurses are always writing, trying to keep up with the documentation. I always choose my patient over the chart, but my charting isn't very good. I **should** do better documentation. So far I haven't gotten in trouble for it, but someday I might.' -RN, L&D

The nurse above expresses a truth that documentation is an important part of her job, and something she feels by all rights she should be doing better. However, she also feels that if she were to document more, she would be compromising the patient. As political and technological changes lead to increasing fragmentation of documentation tasks, it becomes increasingly difficult to maintain this balance. Nurses find it more of a struggle to work in a way that they feel is meaningful, energizing, and aligned with their identity as nurses. This tension plays out in nurses' satisfaction with their jobs. A few experienced nurses at my field site mentioned that they sometimes felt so frustrated with the computers and documentation that they were considering retiring. These complaints escalated when Quest was implemented. This is a real concern as it

is widely acknowledged that there is a shortage of nurses in the U.S. Finding ways to support choreography to keep documentation "behind the scenes" is not just a matter of producing more efficient work, but effectively drawing on nurses as highly skilled professionals with a unique professional and personal commitment to giving care.

### The Logic of a Fragmented Work System

There are different layers of fragmentation in the work of L&D nurses. One is the fragmentation between the two major tasks, patients and documentation. Fragmentation exists within each of these work trajectories as well. Turning to the documentation work system, we can see that documentation work is fragmented into multiple artifacts and environments. Nurses complain that they engage in double, triple, and quadruple charting, documenting the same information in multiple places. Fragmentation is, to some extent, inherent in the nature of documentation- even when there was just a single paper chart in H1, the chart was organized into different sections. Berg and Bowker [7] describe how the medical record is multiple and, taken in its entirety, consists of a large corpus of artifacts including notes on scraps of paper and official documents. What is interesting about H1 is how many different systems are involved in documentation- almost all participants agree the work system is a mess.

However, there is a logic underlying the fragmentation of H1's work system. As described above, the different charting tasks represent different documentation requirements. Layers of infrastructure accrue as new systems are added but old systems are not completely removed. This is logical in the moment as there are functions that may be performed in the old but not the new system. Over time, however, the result is ever-increasing fragmentation. This environment constitutes the set and stage nurses use to carry out their performance, thus inevitably shapes the aesthetics of the performance.

Returning to a situated action perspective, we can see that in the situated practices used by nurses to choreograph multiple work trajectories, fragmentation places physical constraints on action. Accountability requirements constitute a social circumstance that both shape the environment in which the L&D nurses conduct their work (expressed in the fragmentation of the documentation work system) and directives placed on the nurses (to produce a complete chart that stands up to a variety of assessments). Nurses also draw on physical and social resources, particularly the focus that nurses place on caring for patients, to guide the performance and the manner in which they balance work trajectories on an ongoing basis. This research extends current literature on situated action and coordination by examining the physical, social, and cognitive practices that workers use to create an ongoing, situated performance that balances multiple simultaneous work trajectories and the qualities of person and environment that shape the resultant choreography. Future



research could examine the choreography practices, as well as the requirements and resources that constrain and enable choreography performances, in other situations where workers must balance multiple work trajectories.

### Implications for CSCW

#### *Broad Implications for CSCW Research*

This paper provides a starting point for a choreography perspective of action, applicable both in medical contexts and other work contexts. All systems of work, even those that are seemingly mundane, require people to bring disparate heterogeneous tasks together into coherent sequences of action. Choreography takes seriously the actions that connect tasks together in addition to examining the routines and actions involved in completing work. When conducting research on workplace coordination, CSCW researchers should look for choreography practices, such as synching, juggling, and moving, described above. Additionally, this research points to a number of crucial questions that CSCW researchers should confront in a wide variety of studies on work practice and coordination, including: what are the work trajectories, and what are the loci and implements involved in carrying out these different trajectories? How is the infrastructure impacting the choreography? Is the choreography excessively complicated and difficult, in a way that intrudes on successful completion of work trajectories? What are the aesthetics of the choreography, and how do inherent resources of workers, such as ethics and identity, shape the choreography? Do workers find it difficult or easy to choreograph work in way that is satisfying and pleasing?

#### *Implications for Design and Implementation of HIT*

The current research also has several practical implications for design of HIT systems. Past CSCW research calls for HIT designers to consider how medical work involves physical movement in space [5] and temporal rhythms of different members of the medical team [27]. Similarly, documentation work systems should be designed with an eye to the multiple performances that medical workers must choreograph and the quality and aesthetics of the performance that providers would like to achieve. Artifacts could be designed to directly facilitate choreography practice. For example, Chen et Al. [10] found that providers using workstations-on-wheels engage in small adjustments of computer screens throughout an encounter with a patient, moving the screen to strike a balance between the need to document and maintain social contact with a patient. The mobility of the computer enables the provider to juggle the computer and the patient more effectively since she can continuously adjust the computer based on the configuration of computer and patient tasks the provider is balancing at any given time. Designers need to pay attention not just to the tasks that providers engage in, but also how providers transition between tasks.

Although there is a general perception in H1 that “backcharting,” or charting things after the fact, is bad

practice, strategic use of backcharting is an important skill that nurses develop over time. Knowing when and how to backchart can help nurses maintain attention on the patient. Designers should seek to find ways to make it easier for nurses to put down documentation work and return to charting later, thus enabling nurses to more effectively background documentation work as they deem necessary.

Finally, managers and other stakeholders should work to decrease fragmentation of documentation tasks. Task fragmentation is to some extent a natural and inevitable part of work [6]. However, fragmentation in the documentation work stream could be reduced by removing programs from the system and making different parts of the chart multi-task to serve more functions. Finding ways to mitigate fragmentation must take into account the specific context of the work system, including the sedimentary layers of documentation infrastructure and the unique requirements present in each setting.

### CONCLUSION

This paper draws on past research on the situated and agentic nature of coordination to describe how nurses choreograph the work of caring for a patient with the work of documenting information during childbirth. Choreography involves physical, social, and cognitive practices in an ongoing and situated performance that is constrained by accountability requirements underlying a fragmented documentation work system and shaped by the inherent resources nurses bring to their practice, including expertise developed over time and a professional identity that places primacy on patient care.

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