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How to Support Coordination Through Annotations? A Longitudinal Case Study of Nurses' Work in an Oncology Hospital

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Abstract
We present an ongoing research in the field of healthcare computing and coordination support. We focus on nursing work in an oncology hospital. We use grounded theory methodology to structure this research.
After 3 years of work and contributions in the field of communicational approaches of organizations, we are now designing a web mockup in a participative approach.
This paper presents to cscw community an original way for improving coordination processes in healthcare through annotations support.

Author Keywords
Nursing informatics; grounded theory; writing practice; organizing; annotation and coordination support; awareness computing.

ACM Classification Keywords
H.5.m [**Information interfaces and presentation**]: Group and organizational interfaces – computer-supported cooperative work.

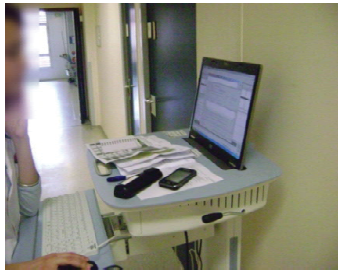

Figure 1. Junior physician is managing heterogeneous sources and flows of information.

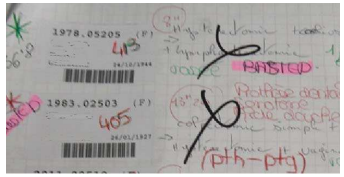

Figure 2. Collective writing of nursing auxiliaries: patients' Id, rooms, main pathology and annotated to do list are quoted.

1 Introduction

Health information management is pointed in literature as a complex process that requires specific skills from caregivers [2, 6, 8]. This process intertwines EMR data, materiality of caregivers' writing, information flows coming from heterogeneous sources, distributed cognition and situated knowledge sharing [1, 6, 8].Health information flows are produced by various media and actors. These flows are addressing various features: patients' data, patients' state and trajectory, medical prescription, individual or collective ongoing action, time management, coordination between caregivers,...[1, 2]. Time management has been characterized as a key resource in healthcare organizing [7]. Finally, annotation support [3] is also identified as core elements to support caregivers' awareness. In this context, we consider that writing practices, in a broad sense, are constitutive of healthcare organization. We propose an original solution that supports annotations and reminders over various dimensions of caregivers' activity and over time. The design of a mockup mixes ground observations, theoretical framework, state of the art and feedbacks from the studied actors.

2 Grounded theory: an iterative enrichment between observations and mockup design

For this research, we conducted an ethnographical study in an oncology hospital over more than 3 years. We used qualitative methodology to constitute our corpus. It is mainly based on observations (90 hours), interviews (12) or spontaneous testimony. We also observed meetings with stakeholders about computer support of nurses' work or training sessions on healthcare software (10 meetings). We gathered audio material, completed by field notes and sometimes by video capture of situations. The matter presented in this poster is based on observations carried out in 3 distinct wards of the hospital (surgery, day hospital for chemo and palliative care) and the pharmacy. We interviewed 2 nurses (quality process referent and pharmacy preparer), 1 matron, the head nurse, the head pharmacist, 1 junior physician, 2 junior pharmacists, the IT head and 3 IT engineers.

These observations helped us to characterize precisely nurses' practices, including those related with the local EMR. Based on this material, we have set up a broad insight of nurses' work including crossed views and longitudinal analysis of healthcare activity. According to grounded theory [4], during our observation, we gradually focused on writing practices and we have identified them as an observable of healthcare organizing.

At the very beginning of our research, we did not mobilize a specific theoretical framework. Conceptualization was finalized through the on-going process of reading state of the art, elaborating research questions and analyzing our observation material. We are now designing an integrative web mockup for improving coordination processes.

3 Writing practices: annotations, reminders, scripts and the myth of zero paper organization

Writing practices of caregivers are not a mere operation of inscribing data. It is a way for caregivers to interconnect heterogeneous data sources and flows (Figure 1). Writing practices are also part of a kinesthetic memory, i.e., the writing gesture is part of the cognitive work of understanding and taking into

Figure 3. Annotations concerning time of prescription are inscribed on pills packaging and on patient's printed record.

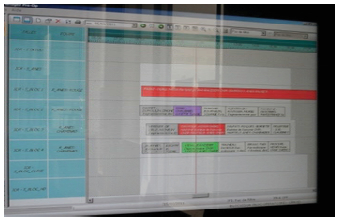

Figure 4. Surgery scheduling is always visible in the ward room. It gives helps coordinating collective action.

account the environment of care (Figure 2). These practices are the means to bridge ambient organization with prescribed and structural organization of work. They also allow caregivers to have a cognitive grip on various temporalities that cross the medicine or surgery wards (Figure 3 and 4).

Those practices also form an inscription of the on-going work of organizing for oneself, for the collective and for the formal organization. For example (Figure 5), we could quote Hutchins and question "How a ward room remembers its patients"? In this example, the way patients' records are arranged on the preparation desk indicates at first sight the actual step in patients' trajectory. This is a key indicator that organizes team work and that coordinates carers.

Finally, these writings are used during transmission period for teams' shift, in order to tell patients' story and negotiate care trajectory evolutions (Figure 6). These writings create an ambient ecology of immediately available information.

All these practices of writing insure reliability, robustness, environment awareness; they help for coordination and knowledge transmission. In this perspective, we consider that everyday writing practices of caregivers are an efficient solution to support cooperation and coordination processes in the observed oncology wards.

4 Results of ethnography and limits:

Both ethnographical observation and mockup design have helped us developing renewed insights about healthcare organization in hospital and about modalities of coordination between actors.

- Caregivers need "information at hand", and they organize their environment for such an issue.
- Caregivers do a huge cognitive work to take together pieces of data concerning patients and organization of work.
- Writing practices and redundancy of written information are an efficient way to deal with flexible and resilient organization. Caregivers produce an "overfilling script" in the ambient context that is often prevalent on prescribed script and organizational script (medical prescription, formal scheduling, and management orders). This local script involves artifacts in a distributed cognition perspective.
- Annotations and reminders are means to synthesize and connect various dimensions of a given situation for awareness, organizing and collective action.

5 The point: Design of an integrative mockup

This poster is based on an ongoing work about an integrative web application which aims to propose: (Figure 7)
- Flexible layouts in order to allow the various practices of writing and various gathering and management of data. We observed this variety during ground observations. It mainly depends on carers' activity and on local organization of wards;
- contextual presentation of data in order to give efficient and delimited data (patients lists, selected data from patients state, filtered scheduling data,…);
- role-based layouts (nurses, healthcare managers, pharmacists, patients,…) in order to take in account the granted functionalities depending on the roles;
- Awareness and coordination support by the means of annotations, reminders and notifications functionalities;

Figure 5. How a ward room remembers its patients? The way patients' records are arranged on the desktop indicates at first sight the actual step in patients' trajectory.

Figure 6. Negotiation time during teams shift. Ambient artifacts are mobilized in the discussions and the decisions.

- Communication tools (instant mail, audio conference and mail);
- Support for cure and care of patient' extended body: medical constants, a synthesis regarding the pathology and hospitalization, caregivers remarks, families ,...;

This mockup is also an original way to present information by playing on its granularity and its form. Annotations can be placed either on objects of activity (patient, time, caregivers) either on texts (remarks, underlining, notifications). We also aim to embed the diverse organizational temporalities in the mockup to offer a core resource for self and collective organizing (surgery scheduling, prescription hour, discharge…).

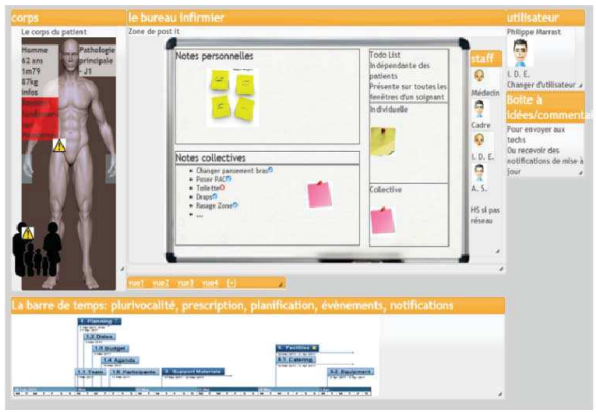

Figure 7. Screenshot of one layout of the web mockup. Patient's figure plus quick synthetic information, white board for individual or collective writing, to do list, communication tool, timeline combining various time schedule.

We have presented this work to the supervisor of care. This feedback led us to reconsider status of writings in this hospital. We concluded that numeric writing creates a fairly strong boundary in the ecology of texts.

This boundary raises questions, such as:
- How writings for oneself or for a closed collective can be managed in distributed software accessible to a whole set of "invisible" others?
- How can we manage situated information that need to be forgotten in a computerized environment? (Previous personal notes are usually destroyed after few days of use and update; and regularly replaced by a new form)

We will focus our future work toward the use of numeric pens [9] to allow carers to create and manage a virtual boundary between the numeric informational system and the local ambient informational ecology. This boundary could be easily set up through turning on/off the device while writing.

6 Conclusion and perspectives

We are in the test phase of the mockup. We need to establish a proof of relevance either through integration test of the mockup or through interviews of users about its functionalities and potential uses.

We have presented to cscw community an original methodology and mockup design to improve coordination processes in healthcare and oncology through annotations support.

This work is actually leading us to reconsider the way writings are taken in account by the organization. The organization of care is in a transitional state. At the very beginning of the EMR, ideology of "0 paper hospital" was prevalent. Now, the ambient ecology of writings is gaining is *nobility letter*.

We assume that our approach of annotation support is a good way to reconcile institutional and formal writings

with ambient, collective and informal writings. This original intertwinement of data could provide a path for more resilient organization.

In a longer term, we will focus this ongoing work toward a formal model of our mockup in order to translate the concept of coordination support by means of annotations to other professional fields.

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