

E-Kardex: Observing the use of Sharp-End Generated ‘Brains’ for Informing the Design of a Hybrid System

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ABSTRACT

Nurses are considered to be one the most adaptive and resilience producing clinician types; they are also one of the biggest users of paper based cognitive artifacts. Cognitive artifacts display information in an external manner to support cognitive processing and recall. The starting assumption is that there is a gap between nurses work-as-done and work-as-imagined such that nurses are generating cognitive artifacts in order to bridge the gap. In order to understand why nurses generate their own cognitive artifacts, the functional usage and value needs to be investigated. This study is anticipated to inform design requirements for EHR-generated cognitive support artifacts which are printed as a handoff report tool at the beginning of a nurse’s work shift.

KEYWORDS

Research; Artifact; Healthcare; Activity management; Electronic health record; Hybrid system

INTRODUCTION

Cognitive artifacts display information in an external manner to support cognitive processing and recall (i.e., augment “knowledge in the head”). In the healthcare domain, nurses extensively rely on cognitive artifacts which display patient information, including lab results, radiology images, allergy lists, clinical flowsheets, vital signs, etc. Two primary electronic artifacts used extensively by registered nurses are electronic health records (EHRs) and electronic medical administration records (e-MAR). The stated intent of these artifacts at the most advanced level of implementation (Stage 7 in the HIMSS adoption model) is to replace the need for the use of paper as cognitive artifacts in the hospital setting (i.e., to have a ‘paperless hospital’). These artifacts are required to be used by the ‘blunt end’, meaning that they are formal tools provided by administrators. Nevertheless, across all known hospitals, the majority of nurses reminisce fondly about functionality previously afforded by paper-based Kardex systems with individual patient summaries kept at a nursing station and maintained across shift boundaries and the use of paper to augment these artifacts is omnipresent with “brains” personal information sheets personally created by individual nurses at the beginning of their shifts. Therefore, we believe that identifying the functionality and value of these two cognitive artifacts will yield ‘cognitive gold’ in the sense of providing insights for designing a hybrid system that combines electronic and paper resources to support nurses’ critical thinking, plan development, care delivery, and remembering elements to include in communications with other clinicians and during a shift change handover.

The conceptual lenses used in the proposed study are heavily influenced by Woods & Cook's (2010) conceptual framework for how organizational ‘blunt end’ factors shape adaptations of expert actors to use knowledge embedded in cognitive artifacts to meet goals despite environmental obstacles in evolving situations. This framework is displayed in Figure 1 and contains evolutions of elements from Neisser's seminal perception-action cycle (Neisser, 1976). This framework modifies schema by environmental exploration based on actors' knowledge, mindset and goals. While our focus is on the ‘sharp end’ nurses in this study who are



Figure 1. Conceptual Framework Diagram (Cook & Woods, 2010)

providing direct patient care, the goals at the organizational level, i.e. ‘blunt end’, are ever-present.

Literature review: What Nurses are creating as a Cognitive Artifact?

Nurses are considered to be one the most adaptive and resilience producing clinician types; they are also one of the biggest users of paper based cognitive artifacts (Gurses, Xiao, 2006). A literature review was conducted which focused on nurses and their interaction with personally created (sharp end) or organizationally implemented (blunt end) cognitive artifacts. Typically, sharp end generated cognitive artifacts are characterized as workarounds in that they are either not actively supported, or even actively discouraged, by the blunt end. Workarounds are defined as a deviation from an intended work process (Lowry, et al. 2015). An area for improving patient safety is reducing the gap between work-as-imagined (typically documented in policies and procedures by the blunt end) and work-as-practiced (typically based on direct observations of the sharp end). The starting assumption is that there is a gap between nurses and the sharp end or nurses would not be generating cognitive artifacts in order to bridge the gap. Overall, workarounds can be both positive and negative. Positive workarounds tend to be unexpected uses for features that were designed for a different purpose, and are typically performed first by individuals and then spread through personal networks, infrequently being spread to all people in a particular role. Negative workarounds tend to be unsafe and improve efficiency or the quality of work life at the expense of safety. There are different reasons for workarounds. There are workarounds which are required because the system does not allow work to be done as imagined, which are done to improve efficiency while increasing safety risks, which are done because of misaligned organizational incentives, and which are sub-optimal and are done because of failing to move to better processes for a variety of reasons. Each of these different types of workarounds has different implications for how to redesign systems and processes. The nurse developed brain is a general workaround performed by individual nurses. In the proposed dissertation study, the brains will be characterized using workarounds as part of the conceptual framework. They act as an example of work-as-practiced, where the brains are a positive workaround that are self-paced and in preparation for event driven activities such that the brains can provide a quick reference to aid recall when time is valuable. The brains are developed for personal use and are not part of the patient’s official medical record.

In order to understand why nurses generate their own cognitive artifacts, the functional usage and value needs to be investigated. Typically, sharp end generated artifacts that supplement EHRs and e-MARs do not contain unique information; in other words, the data are theoretically available in the existing blunt end provided artifacts. Table 1 provides a summary list of functional usage and value for cognitive artifacts, which is extended and modified from a framework created by McLane and colleagues (2012).

Table 1. 12-Typical Baseline Functions for Nursing Artifacts (expanded from McLane et al, 2012)

Functional Usage	Value
Providing a quickly accessible standardized location for finding key information	Develops a snap shot of clinical problems, current condition and care needs; acts as a quick reference
Aiding cognitive processing and internal memory storage	Handwriting improve memory recall of data
Organization of related information in spatial proximity and chronologically	Generates visual cues in order to refocus and get back on track after interruptions
Visual cues to highlight against a background	Highlight important information that is likely to be important
Balance workload and allocate resources	Allows nurses to manage their patient needs with the workload limits for themselves and their clinical collaborators
Provide reference for information needed to access additional information in electronic artifacts and from others	Provide identifying information for patients and contact information for specialist providers
Add, remove, and modify a list of “to do” action items	Develop a guideline or schedule for care planning needs throughout the shift
Support interacting with patient for medication reconciliation task with detailed ordered information	Acts as a reference verification of medication required and when
Chart data over time	Allows nurses to see vital sign changes over time
Support shift change handover	Provides nurses with a quick patient reference and memory aid for verbal updates during handovers
Cross-disciplinary communication	Provides a way to acquire or point to relevant patient information that can be utilized with ad hoc opportunistic interdisciplinary communication conducted away from a computer location

When nurses are asked why they use artifacts in favor of computers the answers typically fall into one of four categories: 1) Computer log-in and updating structured documentation is inefficient and time consuming, 2) Much of the information on the artifact does not have sufficient value over the long-term to be included in the formal chart, 3) Although the information is theoretically available in the EHR and/or e-MAR, it is organized poorly and it is difficult to locate it, and 4) The paper medium has advantageous elements compared to the electronic medium, such as being able to see what information was recently added and what information was previously available before an update (Gurses, Xiao, 2006).

Pilot Interviews: The Kardex: Why do nurses get excited?

Two pilot interviews were conducted with nurses that provide preliminary insights about the functional usage and value of the ‘old’ Kardex paper-based system, which is pictured in Figure 2 next to newer versions which are electronic or hybrid systems. The main insights were that the Kardex was valuable in that

- “It was a compact, mobile, organized structured system, where you always knew where the information was...it was like an operations manual”
- “Its like a guidebook for nurses”
- It was small (5 in X 8 in), , one card per patient, and organized by bed location
- It contained a summary of patient information, including important historical events
- It supported shift change handovers for both bedside nurses (who listened as a group to all updates) and charge nurses

The interviews also identified issues with the old Kardex system, including:

- The medication Kardex included information for all the patients in one place, and tended to be updated less frequently than the other portions of the system
- The Kardex system did not support planning care activities or coordinating activities between registered nurses and personal care assistants

The nurses frequently had personal sheets of paper containing notes which were updated throughout the shift and discarded at the end (which likely were an early and less complex version of “brains” than are used currently). The general feeling during interviews is nurses loved the Kardex because of how the information was presented; it was a one stop shop for their patients information, and it was easy to access contained within a single card. The issues with the Kardex was medication lists were not always up to date, and patient information for patients with long length of stays often ran out of room on the kardex. It was hypothesized by the nurses that the Kardex disappeared because the nursing job tasks evolved and the sharp end required use of other cognitive artifacts, most recently the EHR.

Traditional Kardex					Recent Kardex				

Figure 2 Examples of Traditional and Recent Kardex System

PROPOSED STUDY

Research Design

The design is a mixed-method study with the following components:

- 1) **Semi-structured interviews** of nurses about the functional usage and value of the traditional paper-based Kardex,

- 2) **Ethnographic observations** of registered nurses foraging in the EHR, generating the brains, utilizing it during the initial patient assessment process, and using it during shift change handover
- 3) **Ethnographic observations** of access and functional usage of cognitive artifacts (EHR components, e-MAR, and brains)
- 4) **Digital photographs** of "brains" will be taken during the ethnographic observations at the conclusion of the prior shift, after the new brains are generated, after all patients under a nurses' care have been assessed, and at the end of the four hour observation period

Sample

The sample is:

- 1) **Semi-structured interviews:** 40 registered nurses with Kardex experience obtained as a convenience sample from personal networks

Demographics:

- What is your age?
- What is your sex?
- How many years have you worked as a registered nurse?
- How many years have you been working with an electronic health record?
- How many years had you worked with a Kardex system or similar?
- Which area of nursing do you work (i.e., ICU, PCU, ER, etc.)

Kardex Questions:

- During the era of the Kardex when did you use the Kardex system during your shift?
- What information where you accessing when using the Kardex?
- How was the Kardex organized?
- What information was on the Kardex?
- What information was missing from the Kardex?
- What was your favorite aspect to the Kardex? Least favorite?
- Did you use other paper based solutions in conjunction with the Kardex? Explain.
- Do you have anything else to say about the Kardex?

Transition away from Kardex:

- What do you think was lost when transferring from paper-based records to electronic health records?
- What new functionality was provided that was not available with the paper-based system for documentation?
- Comparing the Kardex to the EHR what would you change? What would you bring back from the Kardex?
- How has the EHR to Kardex transitioned your job process, workflow or job description?

Current EHR use:

- What information did you handwrite that was not in EHR (or conveniently located in the EHR)?
- If used handwritten notes: How does the structure and order of your personal artifacts differ from the EHR?
- If used handwritten notes: How do you organize your artifact and why?
- What would you change about the EHR if you could?
- What is the best part of the EHR? The worst?
- Do you have anything else you would like to tell me about the EHR and or Kardex systems?

- 2) **Ethnographic observations:** Two observation periods for each of 18 nurses during a four-hour period from the beginning of the work shift, including the prior handover, generating the brains, and initial assessment of all patients under their care. Nurses are evenly divided across four participating acute care units from two hospitals in a large academic medical center.

De-identified handwritten notes will be written on spiral paper about strategies and challenges to documenting in the EHR during the observations. Characteristics of brains sheet will be tabulated. Specifically, we will measure the number of categories of items documented on the sheet at the beginning, the number of categories of items added while seeing the patients the first time, and the number of categories of items added during the first four hours of the shift. Categories will be based upon grounded theory bottom-up analysis of the content of the sheets, but are likely to include identifiers, diagnoses, labs, procedures, action items, and contact information. The constant comparison method, a component of grounded theory, will be used to identify strategies. A codebook will be developed iteratively for strategies. Independent coders will classify strategies. An inter-rater reliability

kappa score above 0.70 will be used to determine sufficient reliability across coders. Differences in codes will be resolved by discussion.

DISCUSSION

This study is anticipated to inform design requirements for EHR-generated cognitive support artifacts which are printed as a handoff report tool at the beginning of a nurse's work shift. We are anticipating findings that support elements such as a hybrid electronic/paper system, format suggestions for selected information on an overview summary single printed page, strategies for minimizing documentation time to update electronic structured data, and support for conducting handovers using a blunt end-designed protocol for ordering content

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