Support for Information Management in Critical Care: A new approach to identify needs

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Managing information is necessary to support clinical decision making and action in critical care. By understanding the nature of information management and its relationship to sound clinical practice, we should come to use technology more wisely.

We demonstrated that a new approach inspired by ethnographic research methods could identify useful and unexpected findings about clinical information management. In this approach, a clinician experienced in a specific domain (critical care), with advice from a medical anthropologist, made short-term observations of information management in that domain. We identified 8 areas in a critical care Unit in which information management was seriously in need of better support. We also found interesting differences in how these needs were viewed by nurses and physicians.

Our interest in this approach was at two levels:

1. *Identify and describe representative instances of sub-optimal information management in a critical care Unit.*
2. *Investigate the effectiveness of such short-term observations by clinicians.*

Our long-range goal is to explore the use of this approach and the information it reveals to optimize the process of developing and selecting new information support tools, preparing for their introduction, and optimizing clinical outcomes.

INTRODUCTION

Critical care has traditionally been an ideal environment in which to study the relationship of information management to outcome. Evidence from this and other areas suggests that good patient care can be supported or impeded by information management[1].

We use the term information to cover the spectrum from data to knowledge. For example, the result of a decision is information. We consider information to include clinical information expressed by nurses and physicians verbally, by body language or through artifacts (paper, x-rays, voice, computers, etc.). Most of the information was patient-specific but some was clinical information about groups of patients. Importantly, we also considered what Forsythe calls information deficits[2], i.e. information needs that caregivers have not expressed either because they declined to do so or were unaware of them. We define information management as the process of recording, ordering, thinking about and communicating clinical information. The cooperative-cognitive model of work we have chosen is that of information-decision-action in which teams of caregivers cycle through these three activities.

We examined information management practices "in vivo", that is, as it actually happened, rather than from idealized forms based only on formal descriptions (e.g. policy and procedure manuals) or beliefs or claims of critical care workers. We chose to perform direct observation in addition to interviews and feedback from presentations to the study population because of the well-documented limitations of post-hoc self-reporting methods[2].

We speculated that our approach would provide novel insights into information management different from those resulting from ethnographic techniques. We expected that the clinician would be able to understand the meaning of clinical data much more quickly than a "domain-naive" observer. In addition, he would be able to identify and understand clinical issues that might not be noted by an observer unacquainted with medical issues in this environment. E.g. such understanding would allow identification of information deficits mentioned above. On the other hand, one of the strengths of ethnography is that the observer has fewer domain-specific preconceptions and is less blinded to those events that a clinician "sees" as routine and obvious and not requiring question or analysis. Few clinicians possess the training and experience in anthropologic techniques of observation, interviewing and analysis. Another disadvantage may be a greater Hawthorne effect on the staff due to being observed by someone they perceive having clinical expertise.

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The period of observation should be shorter because the clinician observer already has some understanding of the environment and may be more rapidly accepted into the culture of the Unit. The briefer time commitment is more convenient for a clinician and probably less expensive. Rapid assessment may also be advantageous because critical care Units change technologically so quickly that an ethnographic approach may describe several "evolving" Units over a typical year-long study. What insights may be lost due to brevity is unknown and was not addressed by our study.

Related work in critical care has been done by several groups. Fafchamps[3] focused on strategies to manage difficulties in written and verbal communication. In contrast, we have analyzed information arising from outside the Unit, from computer systems and have looked at the potential clinical impact of decisions made from this information (or not made due to unavailable information). Kalli[4] developed an entity-relationship model of information transfer derived from interviews of critical care respondents. The team led by Donchin[5] used a set of approaches including incident self-report analysis and multiple observations at a bedside to determine causes of error (rather than information issues as we have done).

METHODS

The setting was a 24-bed teaching surgical intensive care unit in a tertiary care institution. Ethics approval was received from the Human Subjects Committee. Informed consent was obtained from nurses and physicians whose practice was observed. The investigator was a Canadian critical care physician (T.W.R.). Data collection occurred in the five phases shown in Fig 1 and described below.

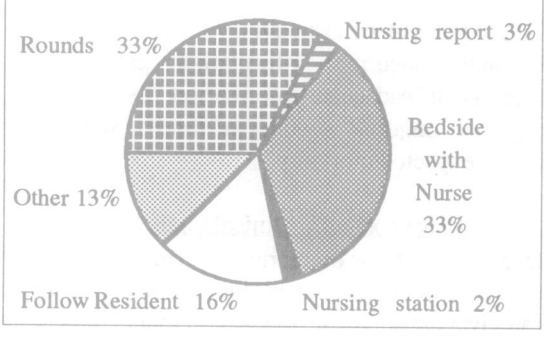

Fig 1. Distribution of time over the 5 phases of the study. Total time was 61 hours, elapsed time was 2 months.

Phase 1. Preconception declaration
To clarify the difference between his pre-study views of critical care information management and those based on observations during the study, the observer summarized his preconceptions based on his experiences and from the literature.

Phase 2. Review of critical care Unit Documentation
The investigator reviewed documents describing the unit's goals and functions and recent demographic patient data.

Phase 3. Observation
Observations were begun within one week of establishing contact with the Unit leaders and on the day of meeting the caregivers. The observer recorded the daily practice in the six activities shown in Fig 2. During any observation, he asked caregiver(s) to clarify the meaning of events as close to the time of their occurrence as did not significantly interfere with their work flow. He maintained concurrent, detailed field notes that he subsequently transcribed (394 observations, 13 pages). He achieved apparent invisibility (He was not asked clinical questions by physicians; rounds and nursing report discussions were obviously candid).

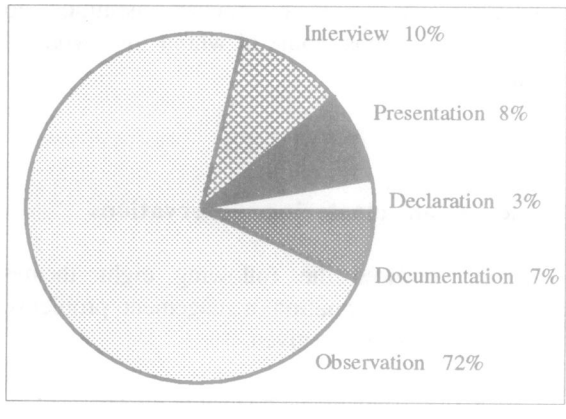

Fig 2. Time activities observed. Total time of observation was 44 hours, elapsed time was 1 month.

After all observations were recorded, they were grouped using critical incident or theme clustering technique. Field observations were analyzed line by line (in the order in which they had been recorded), developing conceptual categories, named themes, for groups of observations. New categories were created as observations were found that did not fit previous

ones. Two more scannings were performed with minor alteration of category (renaming, splitting and collapsing categories) until all observations were accommodated and the number of categories was reasonable. The last two phases were not begun until clustering was complete.

Phase 4. In-depth interviews of selected unit personnel

The interviewees were chosen to reflect the variety of work roles and were selected during the observational phase based on their perceived natural tendency to reflect on practice and their willingness to be interviewed. Included were a Staff Nurse, Nursing Unit Manager, Resident, Fellow and Attending Physician. All interviews were audiotaped and transcribed.

Interviews used the open then closed format to elicit from respondents what they considered information management issues that were important, particularly well done, poorly done and their effect on patient care. They also were used to clarify observations.

Phase 5. Presentation & discussion with unit personnel

Four 15-minute interactive presentations and one two-hour discussion were held with the study's nursing respondents. A one-hour formal interactive presentation was given at another institution to nurses and physicians (some of whom also work in the study Unit).

RESULTS

Themes from clustering observations

Clustering produced the following eight themes which describe information management problems. Illustrative examples are given.

1. Data desert: Unavailable history pre-ICU.
   Important clinical information about the patient before their critical illness is unavailable for too long after Unit admission. e.g. In a patient oliguric after aortic surgery: Resident1 "Son said Patient had 1 kidney, couldn't find in chart". Resident2: "Dr. [surgeon] came in today & said no left kidney". Resident1: "operative note says ... renal arteries" [emphasizes "ies"].

2. Data flooding: Redundant records.
   Clinical information exists in multiple copies; some are merely time-wasting to write and read, some risk inaccurate transcription. e.g. Residents copy clinical data from nursing flowsheet and from lab computer. Takes 50% of pre-round time

3. Data from a cumbersome computer interface.
   e.g. different terminals to reach different areas of lab, frequent needs to re-boot.

4. Data misdirected.
   Although very effective in avoiding communications breakdowns, under-reliance on written record leads to delayed, incomplete or garbled communication. e.g. Residents write orders in the afternoon based on morning rounds decisions. If the nurse is not at the morning round (90% of time), this results in delay in changing non-emergency management of many hours.

5. Over-reliance on spoken word.
   Information often does not reach the most appropriate caregiver. e.g. Busy nurses were typically unable to engage in morning rounds information exchange. An important fungal culture report did not reach the resident or attending who were making critical decisions.

6. Limited standardization.
   Interventions that could be standardized for the majority of patients are not with resultant extra work making or changing decisions. Many local standards already overwhelm the Residents. e.g. Resident1 "Should be on anticoagulation". Resident2 "Cardiology doesn't want because recent amputation". Attending "Lets check with Cardiology and Vascular Surgery".

7. Limited outcomes evaluation.
   Limited concurrent information gathering or subsequent inadequate information dissemination. e.g. No ongoing severity-of-illness scoring to assess expected mortality.

8. Ambiguous short-term clinical goals.
   Decision on 24-hr or shorter clinical goals are not made or communicated in enough detail for those caregivers who must manage patients based on their understanding of those goals. e.g. After a long discussion about ventilator modes, Attending states only: "watch closely as pressure support increased".

Interviews and presentation to caregivers

The interview and presentation phases cast further light on and supported all but one of the themes derived by clustering observations. They did not raise large enough new issues to suggest extending, constricting or otherwise changing the themes.

Concordance

Results are summarized in Fig. 3. It is important to be clear regarding whose point of view is being put forward. The 8 themes are not only the schema developed by the observer but are also based on his own assessments.

In one instance, none of the respondents agreed with the assessment. For theme 2, even though the respondents agreed that considerable redundancy was present in both nursing and medical notes, the degree was considered acceptable.

When opinions differed between caregivers regarding themes, they tended to fall along professional lines. E.g. the interviewed nurses and many others at presentations agreed that Theme 5 (Over-reliance on spoken word) was important and an issue in this Unit. In contrast, physicians felt that verbal communication was not over-relied on. One physician felt that verbal communication was superior to written because it reduced chances of misinterpretation by the listener. One could speculate that another reason for the difference is that the cost of verbal communication is borne by the nurses who are obligated to record their understanding (e.g. verbal orders).

Regarding Theme #8 (Ambiguous goals), all nurses agreed but one physician did not. That physician stated that his role determined that he had little involvement with short-term goals.

	Theme	Observe	RN	MD
1	Desert	■	■	■
2	Flood	■		
3	Cumbersome	■	■	❑
4	Misdirected	■	■	■
5	Spoken	■	■	
6	Standard	■	■	❑
7	Outcomes	■	❑	
8	Goals	■	■	❑

Fig 3. Concordance among data sources.
■ full agreement with observer.
❑ partial agreement.
Blank disagreement.

DISCUSSION

The notion of a critical care physician observer was easily accepted in this critical care Unit. The strong concordance among the themes arising from the three data sources supported theme scope and distinctiveness. The discordances provided a good starting point to explore how role and function influence views of information management. Some results reproduced those in related research noted above. E.g. Dochin demonstrated the dangers of non-standardization and Fafchamps described problems in verbal communication similar to ours.

Many themes suggested difficulty in managing information that falls into the conceptual schema (specificity-formality matrix) discussed by Forsythe. We were struck that the manner in which information was shared, valued and validated among caregivers was remarkably rich but quite informal. The information that seemed hardest to handle and was least documented was that which was complex or "digested" (e.g. diagnosis, degree of certainty, general approach to patient) as opposed to "hard" (e.g. vital signs, medications).

Insight by a clinician observer appeared to be needed to identify theme 4 (Misdirected data - an example of Forsythe's "information deficit") and helped to establish themes 1 (Unavailable history pre-ICU) and 7 (Limited outcomes evaluation). Only four of the eight themes had been noted in the preconception declaration, suggesting that at least half the themes had not obviously been imposed by the investigator's past experience. Nonetheless, since an exhaustive description of any observer's perspective is not achievable, the impact of any observer's preconceptions can be only partially assessed. Our study cannot address the number or kind of insights missed due to the short observational time and the differences in professional training between our observer and an ethnographer.

What implications do our results have for the development of critical care patient information management computer systems? It seems that many critical care Units have solved the first-order challenge of managing large volumes of information with flowsheets, high staff/patient ratios, properly educated

professionals and standard rounding practices, sometimes supported by computer critical care information systems. However, current computer systems address only theme 3 completely. Even though these systems may support improvement in the other seven theme areas, they do so only partially and even then only after careful policy and educational planning. The next-order challenge appears to be how to manage the more complex information resulting from the cognitive processes of individual caregivers and the "communal reasoning" of the caregiving team. The results of an approach like that reported here could help identify areas that need the most support.

What implications do our results have for informatics generally? First, short-term observational studies like this one could provide the basis of needs-driven systems design to support multidisciplinary care. Second, the discordances within and across caregiver roles emphasizes Berg's[3] warning that details of local practice must be accounted for by information systems.

We suspect the examination of other critical care Units with our approach might reveal similar themes. Although the approach is generalizable our results are certainly not. It is likely that each Unit has it's own strengths and weaknesses regarding information management and that individuals within those units might disagree on which is which. Although this paper does not discuss the strengths in information management of the studied Unit, these were frequently recorded. In using our technique to identify areas to "fix", we suggest great caution be taken to avoid lessening the effectiveness of exemplary practices. We also note that some needs for improved information management must rely not on better computer (or paper) tools but on changes in Unit culture and governance.

There are some obvious extensions of this work. How common are the identified themes across Units? Should we develop more detailed, function-oriented models of critical care Units? (Current descriptions record only formal information and make incorrect assumptions about the work of caregivers, e.g. that profession or title determine role). Can we relate clinical outcomes to information management issues? What resources and preparation would a clinician need to effectively apply our approach? How would the process change if the clinician were a nurse? Can this technique be effective in assessing the impact of new information management tools? Can it be integrated into continuous quality improvement and process re-engineering?

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