

**Technical Report**

**Reflections on Supporting and Studying Collaborative Team  
Formation in Post-Cardiac Surgery Care**

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# ***Lessons of CSCW for Collaborative Care Software Support***

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The fields of Computer-Supported Cooperative Work (CSCW) and Computer-Supported Collaborative Learning (CSCL) are multidisciplinary research fields that have studied the theory, design, implementation and adoption of software systems that support people in work and educational settings where people interact with each other strongly as part of their central activities. During the past decade, these fields have reached widespread conclusions that contrast dramatically with previous or naive assumptions and approaches. These conclusions have significant implications for any attempt to provide computer support for team approaches in hospital settings. In this section, a number of the main findings will be mentioned that seem particularly *a propos* based on our studies to date. In the following section, a proposal for software development will be sketched that is in accordance with these principles. Finally, a third section will propose the kind of study of the introduction of this system into practice that is indicated as needed by these findings.

## **Finding 1. Software support often fails**

Despite the impressive progress of computerization throughout society, attempts to computerize have failed massively. So many large, custom system development efforts have failed in industry that it has been debated whether the overall corporate benefits have justified the actual expenses. The impressive successes in computer adoption are the result of the widespread use of a small number of fundamentally simple applications: word processing, databases, email, web browsing. These are basically simple applications, oriented to individual users and broadly generic. They each started with simple functionality that was gradually expanded by large software developers like Microsoft in response to huge markets and with systematic user studies.

Attempts to develop software for group usage is far more complex than single user applications. CSCW and CSCL have repeatedly documented failures at various levels. Often, attempts at implementation discover that actual available technology is not up to the detailed requirements of appealing designs. Implemented software frequently meets widespread user indifference and even resistance to adoption. When group software is adopted, it can cause unforeseen catastrophic consequences due to the elimination of replaced tacit procedures. The CSCW literature is filled with cautionary tales even though people prefer to advertise successes.

## **Finding 2. Build one to throw away**

The minimal conclusion is that designers should never expect their first implementation to be the final, successful system. The transformation of a “good idea” into usable software is in the best case a non-trivial exploration in which many unanticipated issues are uncovered. The software that results will need to be thrown out and rewritten from scratch based on what was discovered, probably multiple times. The recognition of this conclusion was itself a major shock for the engineering approach to software development. The traditional approach was a “waterfall model” of successive stages that were done sequentially with no thought to returning to a previous stage upstream: concept, design, implementation, testing, user studies, dissemination. The new approach requires cyclical revisions to the concept, design, technology, etc.

### **Finding 3. User-centered design**

The whole field of human-computer interaction (HCI) was established in response to the failure of software development by engineers. HCI is based on a user-centered approach that does not rely on the instincts of engineers (or people with “a good idea”) to come up with workable concepts and designs for software, but insists on involving users in the process from the start. The software concept itself should be based on empirical studies of how users work and what their needs are. The field of HCI has come up with a number of techniques for assessing user needs and integrating them into the software development cycle. Unfortunately, few of these techniques address the special and complex needs of software for groups.

### **Finding 4. It always takes longer, even assuming that**

Because the process of transforming an enticing concept into usable software is a highly exploratory process; it is extraordinarily hard to predict the time, effort or cost involved. The more innovative the concept, the more unanticipated findings are likely. It is an underestimation to say that the process always takes longer than imagined, even if one takes into account this principle in estimating.

### **Finding 5. Study practices and artifact usage**

The most important thing is to study carefully how the people you want to support really do their work. A technical trick or “good idea” will not get far. One slogan is “tradition and transcendence”: provide software tools that do the same thing that traditional tools and procedures have been doing in the workplace, and then consider how the computer support can gradually transcend the old ways. New systems must fit well into the established work-flow or they will not be used. People will need to understand the functionality, purpose and processes of the computerized work based on their largely tacit understanding of current practices. What artifacts and symbols are used now? How will they be taken up and/or replaced in the new system? How will people understand the features of the software as they do their work (not from a manual)? How will life be improved for the people who must actually do the new work?

### **Finding 6. Design for the socio-cultural context**

The larger context must be taken carefully into account. For instance, in a hospital setting, what is the power hierarchy, what are the financial constraints, what are the institutional priorities? What about legal restrictions on sharing patient information? Can users be tracked in how they use the system and is that itself a violation of their privacy? Who has the legal right to see information on patients, on minors, on employees? What are the potential consequences for different people of their putting information, opinions or recommendations in written or electronic format? During many interviews at a hospital we studied, for instance, hospital staff and medical professionals uniformly said they did not use electronic communications to conduct their business because they did not want a persistent record of the kinds of information that they were willing to share face-to-face or on the telephone.

### **Finding 7. Iterative evolution instead of deductive waterfall**

Virtually all system development in CSCL today is conducted as “design-based research.” The software design process is tightly integrated with cycles of testing prototypes in realistic settings with groups of users. The idea is to start out with a very simple initial system that groups can readily use and that meets a felt need of theirs. As they use it, researchers study what problems arise and what needs are not met. A next prototype adds some simple functions in direct response to these findings. As cycles of design, implementation and trial take place, the developers gradually learn what works and how to integrate it into the use situation. The software design emerges from this exploratory, user-centered process rather than from some preconception. Of course, a vision of general priorities must

guide the process as well – but this is a matter of *what* the software should support, not *how* that should be done.

### **Finding 8. Build on and extend current practices**

Often, if the time for an innovation has really come, some “early adopters” will have already started to explore, however amateurishly, the new potential. The ideal is to work with them, providing missing technical expertise, but leveraging their tacit understanding of what is needed and what might work.

# ***Proposal for Computer Support of Post-Cardiac Collaborative Care***

**By Gerry Stahl**

This is a computer support proposal for a post-cardiac patient support system. The central idea is that the system should emerge from an initial combination of (a) a website with health care information for the life-long well-being of people who have had heart surgery along with (b) a peer support online community of former patients and their families, within a context of (c) certification and monitoring of information by trusted health care professionals.

This approach is based on the lessons of CSCW presented above. It also responds to a sense that a more ambitious attempt to design a knowledge management system that met the needs of hospital staff as well as patient families would suffer from at least the following problems:

- It would be a multi-million dollar undertaking requiring years of work
- It would have to be part of the hospital recordkeeping system, which has its own set of priorities and constraints
- It would be subject to unmanageable legal, financial and bureaucratic requirements as part of the hospital administration
- It would be subject to crippling restrictions from governmental privacy regulations and insurance considerations
- It would quickly lose sight of the patient and family needs and be overwhelmed by the complex needs of hospital staff, that are easier to define in terms of functional requirements engineering approaches
- Development of computerized patient records is no doubt being done anyway, although without a concern for usage by the patient and family, by consortia of hospitals
- Hospital staff will be reluctant to enter information into a public, persistent system as part of their role within the hospital

The proposed approach builds on major successes in the CSCW field and nascent developments that could be strongly supportive:

- Internet sites with generic health information are very popular. Many patients and families turn to these sites first to inform themselves about health issues. The overwhelming problem with such sites is that the information there has not necessarily been carefully vetted by a reliable source; it is impossible for the public to determine what is trustworthy online information.
- One of the most successful collaborative uses of the Internet is support groups. It is helpful to many people who have had major, life-changing illness to interact online with others who have had similar experiences.
- Mass General Hospital has developed a site ([www.braintalk.org](http://www.braintalk.org)) with vetted information for a wide range of neurological problems, threaded discussion (currently 100,000 threads with 800,000 postings) and chat. There are 40,000 registered members and many more guests (with limited access).
- A small group of former cardiac patients at Concord have banded together to provide information and support for post-cardiac patients.

The proposal is to build an Internet portal site modeled on [braintalk.org](http://braintalk.org) that would provide threaded discussion, chat and links to basic information relevant to post-cardiac patients and their families. Volunteers from the small group at Concord could initially seed and monitor the different parts of the portal, responding to visitors and collecting the most important questions into a summary page of “frequently asked questions” (FAQ). Medical school staff (e.g., interns supervised by professors) could compile and organize relevant medical information (Public Library of Science, Medical Dictionary & Thesaurus, PubMed, Drug Info, etc.) in a format understandable by the public. Cardiac unit staff could develop a description of the procedures used in pre-surgery, surgery and post-surgery, as well as recommendations for home care and life-long post-cardiac health.

This approach would get the project off to an important, concrete start, without running into the imposing obstacles presented by alternative approaches. Given the cooperation of the [braintalk.org](http://braintalk.org) staff, some technical support from the Cincinnati Hospital computer staff, some volunteer time from former patients from Concord, some cyber-librarian research by medical interns and input from the cardiac team, this approach could get off the ground with minimal staffing. A part-time project manager to coordinate everything and a part-time web designer should be able to launch the portal in a half year.

A next step might be to support communication between the cardiac medical team and patients/families after discharge from the hospital. This could take the form of email, with some facility for posting interesting interchanges to the relevant threaded discussion forum or FAQ. Working this out would involve addressing some of the concerns of hospital staff, as well as starting to build out the software system in manageable stages.

Of course, part of the post-op procedure while the patient is still in the hospital would be to orient the patient and family to this online resource. This could start to affect the procedures within the hospital. For instance, verbal and written explanations of a patient’s medicines could be combined with redundant information online. At some point, the portal could be further extended to provide a personalized view for a particular patient that would provide immediate access to drug and other information that is directly relevant to his or her case. As the personalized information became more extensive, provisions would have to be added to protect patient privacy. The system will gradually evolve to meet more needs and to overcome obstacles in small steps.

As people start to use the system it will become obvious how it could be extended and improved. The idea is to start very simply and to let the real needs emerge through use. By starting with the needs of the patient and family after the hospital stay, the focus of the project is tied to the life-long needs of the patient in a way that it will not be distorted by institutional, financial, legal and bureaucratic needs of the hospital system, that would otherwise impose an insurmountable inertia.

# ***Proposal for Social Science Study of Post-Cardiac Collaborative Care***

**By Gerry Stahl**

The need for social science study is two-fold:

1. In order to design software to facilitate an evolution from a traditional practice of medicine to a transcendent practice oriented to the life-long needs of the post-cardiac patient, the actual detailed practices of the affected people (medical professionals, patients, patient families) must be understood both pre and post transformation.
2. In order to reproduce the change in practices in hospital units other than the ones being studied, it is important to have documentation and understanding of what was involved in the studied cases.

The practices that we want to study are those largely taken-for-granted (“tacit”, unstated, non-verbalized) procedures and behaviors that make up the daily life and interactions of those people who interact in the post-cardiac unit. For instance, how do certain people, through their gestures, tone of voice, word selection, manner, etc. set the tone for how things will unfold – who will pose questions, make decisions, end interactions. These detailed interaction and communication practices function to construct the relationships between people and determine how things get done.

The clearest way to identify the nature of these generally unnoticed practices is often to contrast different versions of them in distinctive settings. For instance, we might be particularly concerned with how it is that a patient is given the opportunity to raise an issue that has been bothering him but that he has until this point not felt it was appropriate to raise. In a traditional hospital setting this might be done in one way, in a setting with family rounds in another, in a setting with collaborative teams yet another and in a setting with computer mediation still another way. We would want to study, document and contrast each of these ways.

Various theories of social practice propose different ways to study interactions and relationships (Engeström, 1987; Koschmann, Stahl, & Zemel, 2005; Shumar & Renninger, 2002; Stahl, 2006; Star & Ruhleder, 1996; Vygotsky, 1930/1978; Zemel, Shumar *et al.*, 2005; Zemel, Xhafa, & Stahl, 2005). The theory of mediated cognition recommends that one analyze how interactions are mediated by artifacts. Here, the term *artifact* is extended to include both symbols (like language) and tools (like paper forms and computer screens). A further development of this theory, cultural-historical activity theory, adds the subtle mediations of the socio-cultural context, specifically community relations, the division of labor and social rules. Ethnomethodology argues that *social order* is not some external force imposed on interpersonal interaction, but is actually constructed and reproduced through the ways in which people interact. For instance, the fact that a patient can only raise certain kinds of issues when talking to a surgeon is not some law of proper etiquette, but is a result of the details of how the patient and surgeon (and others) have interacted. It may never have been explicitly discussed by the participants, but a trained observer can discover through careful analysis of an adequate record of the relevant interactions how it was in fact established.

In order to transform the rules of interaction in the post-cardiac setting and in order to provide computer support for the transformed version of the interactions, we should try to understand how the rules are made under certain circumstances and how they might be made differently. That is the goal of this social science research. The exact behaviors or rules of interest cannot be determined in advance. They will emerge from our comparative study, as they began to in our preliminary investigations.

Medical practice stands at a crossroads today. The technical requirements of treating heart disease (at least patching up presenting problems) are basically solved. It is possible for almost all cardiac patients to survive surgery. The challenge now is to deal with the less well-defined problems of helping patients to re-define their post-surgery life with dignity and wholeness. This requires a reorganization of the resources of the medical team and an integration of the patient and his or her family support system into the team as active members with important roles to play. This, in turn, requires a transformation of the interpersonal, relational practices. This is a complex matter, exceeding the schematic views of social science theories. We must adapt and expand the theories and their associated methodologies.

Consider the schema of activity theory: the direct and abstract relation of a subject to an object is mediated first by artifacts and secondly by community, division of labor and social rules. In any given situation, there are likely to be tensions between these various mediating factors, producing problems and/or driving changes. In our study, the subject must be replaced by a team of people, some with medical training (surgeon, PA, social worker, pharmacist, physical therapist, nurse, etc.) and some without (patient, family members). The different team members have different expertise, assignments, interests – yet they need to work together, to make joint decisions, to share information, to work toward a common goal. The object is also complex: to guide the patient into a fulfilling life despite any changes due to the heart problems. This object changes over time, initially day-by-day.

The mediating factors are each manifold. The artifacts include language and medicines that are hard for a lay person to understand. They must be made intelligible if patients are to use them effectively to understand their changed circumstances, to communicate and to heal. The community is intricately structured: a hospital is a world of its own, with confusing hierarchies, subcultures, machinery, restricted spaces. The patient's support community may be extensive or dysfunctional in many possible ways. We may want to offer new community supports through former patients. The division of labor is necessarily well-defined in modern medicine, but it may need to become more flexible to involve patients or their relatives of varying levels of understanding or interest in taking more control of their medical destinies.

Based on our understanding of the core issues involved in transforming post-cardiac care and based on the results of our past year's exploratory studies, we propose a three year social science study. The study will track the changes that take place in specific local units of post-cardiac care at the Hospital of the University of Cincinnati and will document and compare the detailed social practices that take place within those units, primarily those interactions involving the patients and their family members. This study will define different models of teamwork as the units evolve and will document the different forms that specific interactional practices take in these different models. Particular concern will be placed on questions of how the units could take advantage of computer mediation

The explicit purpose of this study is to aid the transformation of the post-cardiac care process to be one that increasingly involves the patient and family in defining the patient's new life. To the extent possible, the project will follow the patient home to see how the patient interacts with the Internet portal proposed above. In this sense, the study is an instance of involved action research. The research team will exert its influence through periodic reports and meetings with Vice President Dr. Paul Uhlig.

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