Patient care information systems and health care work: a sociotechnical approach

Marc Berg *

Institute of Health Policy and Management, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands

Received 9 November 1998; received in revised form 20 January 1999; accepted 25 January 1999

Abstract

Those who face the difficulties of developing useful patient care information systems (PCISs) often stress the importance of ‘organizational issues’. Building upon recent sociological insights in the construction and use of information technologies for (health care) work, this paper underscores the importance of these insights for the development and evaluation of these systems. A sociotechnical approach to PCISs in health care is outlined, and two implications of this empirically grounded approach for the practices of developing and evaluating IT applications in health care practices are discussed. First, getting such technologies to work in concrete health care practices appears to be a politically textured process of organizational change, in which users have to be put at center-stage. This requires an iterative approach, in which the distinctions between ‘analysis’, ‘design’, ‘implementation’ and ‘evaluation’ blur. Second, a sociotechnical approach sheds new light on the potential roles of IT applications in health care practices. It is critical of approaches that denounce the ‘messy’ and ‘ad hoc’ nature of health care work, and that attempt to structure this work through the formal, standardized and ‘rational’ nature of IT systems. Optimal utilization of IT applications, it is argued, is dependent on the meticulous interrelation of the system’s functioning with the skilled and pragmatically oriented work of health care professionals. © 1999 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Patient care information systems; Health care work; Sociotechnical approach; Electronic patient record; Medical decision-making; System development; System implementation; Evaluation

1. Introduction

‘Developing a comprehensive medical information system’, Morris Collen concluded in his historical survey of medical informatics in 1995, appears “a more complex task than putting a man on the moon had been” ([1] p. 464). Although we hear much more about successes, certain benefits and the need to implement patient care information systems (PCIS) in health care, the fact is that most applications to date have failed. Large numbers of systems never make it off the drawing table—and if they do, they do not appear to be transportable out of the specific context in
which they were developed [1–7]. Although precise data are lacking, a general handbook on management information systems estimated that from the large systems that end up being used as much as 75% should be considered to be operating failures. They might be in operation, but they are too cumbersome, too expensive or too functionally deficient to be even remotely called a ‘success’ [8]. And in a recent overview of clinical data systems, Jeremy Wyatt mentions a staggering figure of 98% of software built for US government use that was ‘unusable as delivered’ [9].

Those who are facing the enormous difficulties of developing useful PCISs often stress the importance of ‘organizational issues’ [10,11]. Building upon recent sociological insights in the construction and use of information technologies for (health care) work, this paper underscores the importance of these insights for the development and evaluation of these systems. A ‘sociotechnical approach’ to PCISs in health care will be outlined. After introducing the central starting points of this empirically grounded approach (Section 2), two implications of this approach for the practices of developing and evaluating IT applications in health care organizations are outlined (Section 3). First, getting such technologies to work in established practices appears to be a politically textured process of organizational change, in which users have to be put center stage. This requires an iterative approach, in which the distinctions between ‘analysis’, ‘design’, ‘implementation’ and ‘evaluation’ blur. Second, a sociotechnical approach sheds new light on the potential roles of IT applications in health care practices. It is critical of approaches that denounce the ‘messy’ and ‘ad hoc’ nature of health care work, and that attempt to structure this work through the formal, standardized and ‘rational’ nature of IT systems. Optimal utilization of IT applications, it is argued, is dependent on the meticulous interrelation of the system’s functioning with the skilled and pragmatically oriented work of health care professionals. These implications will and cannot take the form of ‘formulas’ for successful system development. Rather, the sociotechnical approach is inherently critical of overly methodical ‘guidelines’ promising success. The implications this paper will sketch are intended to reorient the way we tend to investigate and manage these processes. It attempts to offer new perspectives rather than a list of ‘critical success factors’; it engages in constructive critique rather than in delivering yet another set of guidelines for design and implementation. This does not mean that the sociotechnical approach is ‘philosophical’ or merely academically, research oriented. To the contrary: we claim that for a successful management and realization of concrete development processes, such an approach will ultimately prove to be more useful.

2. The sociotechnical approach: starting points

Some 20 years ago, the term ‘sociotechnical system design’ was used to indicate design approaches that stressed the importance of job satisfaction, workers’ needs, and skill enhancement [12–14]. These approaches put people and their working relationships center
stage and formed a long-needed antidote to the technology-centered and top–down approaches that dominated system development. In current times, the term has drifted from this direct focus on workers’ emancipation. Embracing a user-oriented perspective, sociotechnical approaches emphasize that thorough insight into the work practices in which IT applications will be used should be the starting point for design and implementation [8,15,16]. This is especially important in organizations that pivot around the work of professionals [17]. Since any potential benefit that IT might bring to health care has to be realized at the level of the concrete interactions with these tools, it is here that any development or evaluation process should start. Building upon previous research and literature reviews [18–20], the specificity of the sociotechnical approach to IT applications in health care is characterized in the following three points.

2.1. Health care practices are seen as heterogeneous networks

In the sociotechnical approach, work practices are conceptualized as networks of people, tools, organizational routines, documents and so forth [21,22]. An emergency ward, outpatient clinic or inpatient department is seen as an interrelated assembly of humans and things whose functioning is primarily geared to the delivery of patient care. The work of doctors and nurses articulates with the functioning of monitors, of order forms and laboratory routines to keep an Intensive Care patient stabilized, to treat an acute traffic accident victim or to provide long term care to a chronic diabetes patient. In performing these primary goals, secondary aims have to be served as well. Teaching interns, doing clinical research and meeting budget objectives are all to be achieved by many of the same people and tools, and often as part of the care process itself [23,24].

The tools, documents and machines are ‘constitutive’ elements of these work practices. If one would pull away even a simple object such as the order form from an average Intensive Care Unit, that work practice could not continue functioning in its current complex and smooth manner [25]. The roles and tasks of doctors and nurses are tightly interwoven with each other and with the operations of these other elements. Just like the tasks and position of doctors have changed, historically, with the coming of the stethoscope and the emergence of laboratory tests, the current roles and tasks of health care professionals are intertwined with the functioning of record systems and the architectures of their work environments [26–29]. Simple forms and room designs structure the way their work is organized, the way their responsibilities are distributed, and the nature of the doctor–nurse relationship.

The elements that constitute these networks should then not be seen as discrete, well-circumscribed entities with pre-fixed characteristics. Rather, these entities acquire specific characteristics, roles and tasks ‘only as part of a network’ [30]. A ‘physician’ is only a ‘physician’ in the modern western sense because of the network of which s/he is a part, and which makes his/her work and responsibilities a reality. Without nurses, record systems or the stethoscope, the Medical Doctor as we know it would and could not exist. Because of this tight interrelation between elements in a network, the introduction of a new element (as when a PCIS is implemented), or the disappearance of an element (as when a hospital stops training junior residents) often reverberates throughout the health care practice. The introduction of the patient centered record in the US at the beginning of the twentieth century, for
example, necessitated changes in hospital architecture and the emergence of the new profession of medical record managers. It was also tied to the changing position of the physician from an enterpreneuring gentleman to a methodical member of a team: it changed record keeping from a private affair to a matter of cooperation with (and potential criticism of!) colleagues [31,32]. Similarly, shifting from paper-based recording practices to electronic record keeping often makes work practices (and especially the record-creating activities themselves) more visible, inspectable and manageable. This can have large consequences for the interprofessional relations within the hospital [33,34].

Yet although the effects and functions of IT applications in work practices can be highly consequential, the precise shape they take is not pre-determined. They evolve within the specific, socio-political contexts of these practices. As Kling and Scacchi phrased it, the introduction of technologies in work practices is ‘embedded in a larger system of activity, (has) consequences which depend on peoples’ actual behavior, and (takes) place in a social world in which the history of related changes may influence the new change’ [21].

The sociotechnical approach, then, is hesitant to speak of ‘organizational issues’ or ‘human factors’ in its analysis of IT applications in work practices. Although it is crucial to stress the importance of the ‘social’ in a predominantly technology-oriented environment [17,35], there is no distinct set of ‘issues’ that has to be ‘dealt with’ in developing IT applications. Nor are there pre-fixed ‘human factors’ that inevitably come to play. In the practices that are at stake, technologies and humans are closely interwoven, with more or less frictions, aligned towards the performance of common tasks. Which ‘issues’ and ‘factors’ are at stake depends on the network in question. When the network changes, the ‘issues’ and ‘factors’ are transformed as well. An IT application in a health care practice should be seen as forming a seamless web rather than a Technology in an Organization [22]. In addressing, managing and studying this network, one should not attempt to pry it apart in a ‘social’ and a ‘technical’ system. ‘Technology’ and ‘organization’ do not occupy separate domains or operate according to separate logics; nor does their relationship develop in some unilinear way (the former ‘causing change’ in the latter or vice versa). The interrelated elements constitute an assembly that should be dealt with as a whole rather than as a Technical subpart for the IT engineers and a Social subpart for the social scientists [2,21,36,37].

2.2. The nature of health care work

The core activity of health care work practices is ‘managing patients’ trajectories’: doing investigations, monitoring, intervening and re-intervening in order to at least temporarily cure or palliate patients’ problems [2,24]. In all but a few instances, managing patients’ trajectories is a collective, cooperative enterprise. Even the individually operating general practitioner communicates with his/her colleagues. A fundamental characteristic of this work is its pragmatic, fluid character. Like other complex work activities, it is characterized by the constant emergence of contingencies that require ad hoc and pragmatic responses. Although much work follows routinized paths, the complexity of health care organizations and the never fully predictable nature of patients’ reactions to interventions result in an ongoing stream of sudden events. These have to be dealt with on the spot, by whomever happens to be present, and with whatever resources happen to be at hand [2,24]. In addition, and partly because of this phenomenon, health care work is typ-
ified by ongoing negotiations about the nature of the tasks and the relationships between those who execute the tasks [38,39]. The sociologist Hughes [40], for example, has documented how experienced nurses often help inexperienced residents by suggesting the way towards the diagnosis, or by hinting towards the necessary treatment. These are subtle interactions: the doctors are formally responsible for these actions, and their social status disallows them to be too ignorant too openly. Likewise, physicians in Dutch hospitals often informally negotiate with nurses that the latter order routine drugs, or give intravenous injections, while they are ‘officially’ not allowed to do that.

Health care work is further characterized by its distributed decision making, by ‘multiple viewpoints’ and by its ‘inconsistent and evolving knowledge bases’ [38,41,42]. During the patient’s trajectory, many authors and events exert their influence on the course of events. There is rarely one individual who truly oversees the whole chain of events and decisions. More often, the shape of the trajectory is the contingent result of small decisions and steps taken by individuals from diverse backgrounds and with varying viewpoints about what is the case and what should be done.

All these features of health care work point towards the importance of the last characteristic to be discussed here: the ‘articulation’ work that keeps such complex practices going. The sociologists Gerson and Star, speaking about complex work activities in general, describe this work as such:

all the tasks involved in assembling, scheduling, monitoring, and coordinating all of the steps necessary to complete a production task. This means carrying through a course of action despite local contingencies, unanticipated glitches, incommensurable opinions and beliefs, or inadequate knowledge of local circumstances. …[Since] no formal description of a system (or plan for its work) can…be complete…every realworld system thus requires articulation to deal with the unanticipated contingencies that arise. Articulation resolves these inconsistencies by packaging a compromise that ‘gets the job done’, that is, that closes the system locally and temporarily so that work can go on. [38] (cf. [24,43])

Although it can be seen as the ‘glue’ that holds complex work practices together, articulation work tends to be paradoxically invisible to outsiders [44,45]. It does not result in clear-cut ‘products’, it is not highly valued, and it is generally not even recognized in work descriptions or by managers. It will come as no surprise that in health care, primarily nurses and assistants perform this work.

The sociotechnical view of ‘work’, then, is at odds with traditional views of work prevalent within IT development in at least two ways. First of all, it emphasizes the need to address ‘cooperative work processes’ rather than discrete tasks for individuals. Most discussions and concrete attempts in health care informatics focus on the individual doctor or nurse, and model his/her ‘decision making process’ as if that could be depicted as a sequence of logically distinguishable steps [18,46,47]. Most concrete designs ‘seem to encompass a rather restricted view of collaboration’: a design that assumes individuals using the computer alone, for individual tasks, which have to be completed before another user might continue [48]. They might focus on the importance of order entry, but they will rarely focus on the way order entry, for example, is intermingled with the ‘larger process of assessing/reassessing patient status…and developing the care strategy’ [49]. And they may pay much attention to the
development of a nicely looking clinical workstation, but just how this workstation’s functions will be used in meetings or by residents that are constantly interrupted rarely receives sufficient attention [49,50].

Second, the sociotechnical view of ‘work’ fundamentally undermines the idea that the ‘essence’ of work practices can be caught in pre-fixed workflows, clinical pathways, formal task descriptions or other formal models [38,51]. Such descriptions are useful (see also further), but it should not be forgotten that they are only highly incomplete, summarized and rigid depictions of the modeled work practices. There is no a priori or algorithmic connection between any particular formal description of an action and its specific occurrence [52]. Any concrete work activity only unfolds ‘in the doing’, in constant interaction with the contingent circumstances that make up the situation in which it is located [51]. A gynecologist confronted with a newly pregnant patient, for example, can leave the ‘standard’ path of actions because of a myriad of reasons. The patient might be so insecure that she foregoes some routine tests in order to comfort her; she might skip a standard blood test because she knows that a colleague whom is also treating this patient will perform this test anyway; she might not ask certain ‘standard’ questions because of a particularly painful history of a stillborn child. The list is endless.

This issue is important to stress because rationalist, technology-centered discourses are still all-pervasive within our field. Such discourses emphasize the messiness of current work practices, the need to weed out variability in practice, and the opportunities of PCISs, protocols and other such tools to finally bring ‘structure’ and ‘rationality’ to the work of doctors and nurses. This issue is complex and multifaceted, and cannot be satisfactorily dealt with here [2,53–57]. Yet given the dangers of importing too much pre-fixed structure in health care work, and given the resources that are currently spent on creating more fine-grained, more directive protocols for more aspects of this work, it is imperative to continue querying what ‘good’ all these efforts will bring. In the light of increasing evidence that too much structure obstructs worktasks and puts additional burdens on health care personnel [55,58,59], careplans are being produced and promoted as if ‘more is better’. In the light of abundant sociological evidence as to information-richness of free text and the practical efficacy of brief, handwritten notes [16,28,60], such practices are being scolded as ‘non-scientific’, ‘un-professional’ and ‘outdated’ [61,62]. This is not to say that there are no problems with current practices, or that formal tools hold no promise-far from it (see Section 3.2). Yet as I will argue in Section 3, we will only be able to fully realize these benefits when we adapt a more empirically informed view of the work of doctors and nurses, and a more modest view of what these newest ‘solutions’ can bring.

2.3. Empirical orientation, with emphasis on qualitative methods

It follows from the above characteristics that the sociotechnical approach emphasizes the importance of deep empirical insight into the work practices in which an IT application will be used. It is imperative to acquire insight into the ongoing workflow and ‘negotiated orders’ [63] of these practices before we can even begin to consider developing (or buying) a system. Similarly, we need to know what the specific network that constitutes a health care practice looks like before we can think of realizable implementation strategies or meaningful evaluation criteria. The sociotechnical approach is thus skeptical of ratio-
nalist models in which the existence of common goals, predetermined tasks and a limited number of formal procedures is assumed and therefore found wherever one looks [15]. Models may aim at universality, at being generalizable over individual health care practices, but this should be a bottom–up exercise, generalizing from empirical cases. It should not be a top–down approach of creating universal ‘domain information models’ in which all concrete instances of actual health care practices should fit. Nor should we loose ourselves in trying to map the ‘basic structure of medical knowledge’; to create a ‘foundation’ upon which then all individual instances of medical action could be easily mapped. Such exercises are fruitless at best—and all too often result in stifling and rigid frameworks [64].

The required empirical knowledge can be made available in two ways, which should both be used. First, end users should be involved (see Section 3.1), and second, qualitative research methods need to be employed. The use of interviews is generally not adequate for the level of insight required: ideally, participant observation forms the starting point of any sociotechnical development or evaluation process. It is difficult to acquire a feeling for the intricate interrelations between health care professionals and (paper or electronic) documentation techniques without having seen the work patterns itself. Likewise, to get a grasp on the flows and forms of information a health care professional handles in a specific ‘patient care scenario’ [49], we cannot limit ourselves to interviews or surveys. Without detailed, on-site insight, an adequate grasp of what IT functionalities should be available in what form is practically impossible [65].

Qualitative research methods are similarly essential to any thorough evaluation of an IT implementation. Simple quantitative measures (such as user satisfaction, usage indicators, time studies) may be useful, but they need to be grounded in qualitative data so that their meaning can be understood. Why is satisfaction high for function A but low for B? What is the reason for fluctuating use times? Such questions can only be thoroughly answered through detailed, qualitative research [35,67]. The broad, socio-cultural and political implications that IT applications can have in health care practices, moreover, is an additional argument for using qualitative evaluation methods. Since impacts can be wide-ranging and unpredictable, pre-set measurement instruments often miss the most relevant changes that take place, or loose track of the way variables affect one another [68,69]. Finally, qualitative research methods are the most suitable way to study changes in tasks, roles and responsibilities. We may do a time-study of documentation practices, but if the nature of a nurse’s tasks changes, the time-study looses most of its relevance. Typically, implementing PCISs generates such changes, and a central focus of the system’s evaluation should be a thorough investigation of these [2].

3 More complex quantitative measures—such as overall economic return, or overall impact on health care outcomes—have proven to be methodological nightmares, and have only rarely yielded unequivocal results. Reasons are, amongst others, the broad and diffuse impact of the implementation of IT systems in organizations, and the state of general structural change in which most health care organizations find themselves. In a network in which professionals’ tasks are changing, new views on quality are emerging and cultural notions of what proper documentation means are transforming, it is virtually impossible to distill and causally link the influence of one fixed variable—the IT application—on another. See Ref. [66] for a fair juxtaposition of quantitative and qualitative evaluation methods.
3. Implications of a sociotechnical approach

Adoption of a sociotechnical approach has implications for a range of issues within the development and evaluation of IT applications in work practices. It changes the way we think about the very concept of medical information [55,70,71], it transforms our view of the way IT is embedded within organizations [72,73] and it problematizes any suggestions of a ‘formula’ for successful system development [3,11,37]. It is impossible to do justice to all these implications in the scope of this article. Here, two implications will be developed in some detail: the merging of the activities of development and evaluation in an iterative, cyclical process, and the positioning of the formal IT application within the fluid and pragmatic nature of health care work.

3.1. An iterative process in which system development and evaluation activities merge

Developing an IT application in health care practices can never be a process of ‘simply installing and using a new technology’ [15]. The deep intertwining between technological and human elements of the networks at stake implies that any design and implementation attempt is necessarily related to widespread transformations in these networks. Whether the system developers are aware of this phenomenon or not, these processes are inevitably political. They affect the distribution of responsibilities and the hierarchies between professionals and between professionals and management [45,70,74]. Different groups might see the technology as a way to achieve their potentially conflicting goals [59,75], and the technology, consequently, may embed values and assumptions that are not shared by everyone [64,76,77].

The sociotechnical approach argues that development projects should be seen and managed as being the politically textured, organizational change processes that they inevitably are. Closing one’s eyes for these realities can only lead to failure through ‘resistance’ and even ‘sabotage’ by users who are not taken seriously [3,17]. System development projects, then, need to be user-centered. This implies more than a GUI, good communication or adequate training programs. To obtain this support, to generate commitment and to ensure user-driven design and implementation, users need to be involved early, thoroughly and systematically [49,78,79]. This is easy to state as a slogan, yet hard to achieve in practice: balancing the do-ability of a project and the granting of user-input is a very complex task. Preventing conflicts between users to thwart the project, preventing the project to become a mere users’ wish list, and keeping an overall, coherent information strategy in place are just a few of the challenges that await any such project [8,80,81].

The work of PCIS analysis, design and implementation, then, can itself be described in the same terms as health care work has been described above: it is a collective, cooperative enterprise, which is characterized by the constant stream of contingencies. Ongoing negotiations about the scope and aims of the project, the role of the project management and the responsibilities of the project team members are the rule rather than the exception. Here as well, decision making is distributed, and work is guided by multiple viewpoints and inconsistent and evolving knowledge bases [38,82–84]. Because of the political nature of these processes and the importance of the user, and because of the fundamentally unpredictable nature of these change processes, an iterative approach to development is required. Start-
ing with central organizational needs, systems have to be developed step by step, so that the changes in technology and work practices can evolve together [11]. Contrary to top–down design and implementation attempts, iterative approaches acknowledge the impossibility to foresee all consequences, and they can creatively draw upon encountered problems or unanticipated use in the further development of the system. For traditional, top–down approaches, such inevitable effects can only obstruct the implementation and proper functioning of the technology. Iterative approaches, on the other hand, allow for creative, organizational and technological co-development.

Successful development processes, then, do not emerge from attempts to install ‘hegemonic’ systems whose rationality and power subsumes all other elements. Rather, ‘powerful technical systems comprise...artful integrations’ between working practices and new and old devices [37]. Such integrations should be allowed to gradually emerge rather than brought about through enforced revolution [39]. This is even true for such seemingly technical and elementary issues such as standards (compare, for example, the success of the pragmatically structured, flexible and bottom–up developed Internet protocols with the small impact of the formalistic, layered, inflexible and top–down structure of the ISO/OSI alternatives) [72,85,86]. ‘Growing’ such systems implies entering ‘into an extended set of working relations, of contests and alliances’ [11,37]. In such a process, the distinctions between system ‘analysis’, ‘design’, ‘implementation’ and ‘evaluation’ blur. Strictly speaking, within a sociotechnical perspective it hardly makes sense to consider them as separate activities [81,83]. Users are involved from early on in the analysis, and feedback from early implementations immediately informs further analysis and design. With design continuing during implementation, and ‘evaluation’ informing analysis and design, ‘analysis’, ‘design’, ‘implementation’ and ‘evaluation’ become co-occurring activities. These processes should be organized and managed as such, and the different expertise required should be integrated in any PCIS project team.

A modest and imperfect example of such a process has been described in this journal before [16]. In the adaption of a commercial PCIS package for Intensive Care departments to the specific needs of a IC in a Dutch Research Hospital, IC nurses and an anaesthesiologist from the department in which the system would be placed were trained so that they could take full responsibility for the tailoring process. In this way, the distinction between ‘users’ and ‘designers’ truly blurred, and ongoing evaluations from real-time use were constantly fed back into the ongoing tailoring process. The pressure and presence of real-time demands, and the ongoing co-occurrence of design and evaluation continually ensured an artful integration of the system with the surrounding working routines. Part of the success of this implementation, however, was due to the small scale of the sociotechnical change: record keeping procedures in the wards around the Intensive Care remained unchanged. This obviously generated problems when patients were transferred between wards. A larger sociotechnical change might involve introducing similar packages on these surrounding wards—yet one problem that is encountered is that the vendor of the IC PCIS package does not provide ‘general ward’ packages that would suit the needs of a surgical or internal medicine ward. (See for other examples, e.g. Refs. [11,49]).
3.2. The PCIS as a tool in health care work

What is it that IT applications can do in health care work? If we ban all advertisement rhetoric and tendencies towards hegemonic systems, we can discern two modest yet potentially powerful roles that PCISs can play in health care work. Information technologies enable professionals and organizations to 'accumulate' data-elements into meaningful wholes and to 'coordinate' complex processes of interaction and collaboration [87]. They collect and aggregate data entered (into a graph, list or possibly a reminder) and so afford new levels of overview, and they link activities of doctors and nurses across different times and spaces [88]. IT’s potential to take over these tasks is often greatly exaggerated. The active and efficient way in which paper-based documentation technologies can perform these roles is generally underestimated. Also, even when IT applications are omnipresent in a workpractice they only touch upon a part of the information handling and coordination that takes place [18,87,89–91]. Yet PCISs obviously may perform accumulation and coordination functions more powerfully than traditional paper based documents could. IT applications can bring their computational power to bear to create summaries, graphs or reminders [92–94], and fast electronic links can ensure coordination between events taking place in geographically separate locations.

In general terms, then, information technologies afford networks to span over larger numbers of entities. Larger numbers of data can be assembled and dealt with by the same professional, and more events in more distinct spaces and times can be brought together. This is the generative power of formal tools: in the interlocking of such tools with human work activities, new competencies for health care professionals can be produced, and higher levels of complexity in work tasks can be achieved [20,57,87,91].

Several important observations follow from seeing the tool as being interrelated with other elements in the performance of overall tasks. First of all, conceptualizing IT applications as tools that form ‘artful integrations’ with health care professionals and other instruments focuses the attention away from overly ambitious attempts to ‘replace’ the paper record, or to ‘clean up’ medical decision making. IT applications should be developed so that their practical strengths articulate optimally with the practical strengths of health care professionals and, for example, paper documents. This is a different and more fruitful focus than attempts to ‘mirror’ doctor’s reasoning or to create a ‘paperless’ environment. Too often, designers and managers mistakenly invest in ‘smart machine’ solutions because they overestimate the self-sufficient powers of IT, and overlook the skills that are already present in the work practice. In such circumstances, a more ‘dumb’ solution, with a retraining of already rather skilled personnel, would often be cheaper and easier [95]. Similarly, because designers and managers underestimate the richness and ‘ecological flexibility’ of paper documents, useful resources and work routines are often destroyed and replaced with much less flexible and more expensive ‘solutions’ [48,95]. IT is better in repetitively amassing and monitoring data than in making patient-specific judgments about them. It is excellent in fast transmission and search capabilities, but it lacks paper’s ability to be shuffled around, leafed through, and provide overview [48,89].

Finally, this analysis returns us to the seeming conflict between the fluid, cooperative and necessarily ‘messy’ nature of work practice and the formal, standardized and comparatively rigid functioning of IT. As
stated in Section 2, one of the largest mistakes that PCIS developers can make is attempting to ‘replace’ the messy and ad hoc nature of that work with the straightforwardness and ‘rationality’ that the system seems to promise. One of the most dangerous yet widespread tendencies in the field of PCIS development is taking the tool’s characteristics as ideals to which the work practice should be molded. Rather, the optimal utilization of PCISs is dependent on the meticulous ‘interrelation’ of the system’s functioning with the skilled and pragmatically oriented work of health care professionals. First of all, formal tools such as PCISs only survive in health care practices because of the skilful work of health care professionals. Tools that embed pre-fixed sequences of steps in a care process, or that only allow certain modes of data input would perish amidst the contingencies and pragmatic needs that characterize health care work—were it not for the balancing acts of health care professionals. These professionals translate vague answers into one of the preset ‘codes’ on the form, or modify a proposed care path so that a patient can spend a weekend with his family, or do several diagnostic tests in one batch. They often establish ‘workarounds’ to trick the system so that it keeps on functioning without interfering with the acute, practical situation at hand [96,97]. (One workaround, for example, is a nurse resetting the computer’s clock so that orders can be entered post hoc [87]). Formal tools such as PCISs, then, paradoxically seem to be kept ‘alive’ by the very same ad hoc and pragmatic activities that they are often set out to erase. The ‘irrational’ practices that the ‘rationalizing’ tools would smooth out actually are a ‘sine qua non’ for the tools’ smooth functioning [2,96,98].

The skilful activities of health care professionals keep PCISs functioning—and in properly developed PCISs, the functioning of these systems in their turn enhances the professional’s responsibilities and competencies. In well-designed systems, coding data and working upon preset carepaths can generate the possibility to do research, or alleviate the burden of routine tasks [57,87]. In the IC PCIS system described above, for example, the system helped calculate the fluid balance in a way which saved the nurses time and gave them continuous access to the current value of the fluid balance (whereas with the paper system, the actual value would only be calculated once every 24 h) [16]. Similarly, several general practitioner PCIS systems have well-developed, simple coding schemes built in, so that the GPs can ‘code’ their diagnoses and actions with a few simple mouseclicks [94]. In a well-guided development process, the application and the health care professionals ‘enable each other to affect each other’ in their mutual interactions. When tools are carefully inserted in the pragmatically structured activities of nurses and doctors rather than seen as a ‘solution’ to this ‘messy’ nature, their skilful interaction with the tool will afford it to exert, in its turn, its generative power.

4. Conclusion

The sociotechnical approach cannot be seen as a simple ‘solution’ to the many problems haunting PCIS development. It does not automatically yield a list of superior system requirements, nor does it answer the everyday problems of a manager in charge of an implementation project. The approach raises several issues that have no easy answers: how to find the optimal form for the iterative development process in an environment full of economic pressures for ‘fast results’, divergent interests, and inflexible IT applications?
Where to find the optimal interrelation between the formal tool and the health care professionals’ skills? Yet its view on health care practices and health care work, and its emphasis on empirical, qualitative insight into these practices and processes will not only improve our analytical understanding of these phenomena. Approaching health care practices as heterogeneous networks, and recognizing the pragmatic and skilled character of doctors’ and nurses’ work is a crucial first step towards PCISs that will articulate more powerfully and more artfully with their surrounding networks. Seeing the PCIS as the outcome of politically textured negotiation processes, moreover, will help us face this challenge up-front. It will also help us recognize this technology for what it is: a tool that may radically transform the shape and structure of current health care practices.

Acknowledgements

I would like to thank Emilie Gomart, Els Goorman and Berti Zwetsloot for the inspiration and comments that led to this paper. This research has been made possible by a grant from the Netherlands Organization for Scientific Research (NWO).

References

[50] K. Henderson, Flexible sketches and inflexible data bases: visual communication, conscription


[58] E. Goorman, M. Berg, Modelling nursing activities: electoronic patient records and their discontents, in press.


