IDEA GROUP PUBLISHING

701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com

ITP5032

Conceptualization of Information, People and Technology in Medical Informatics Research

Yin Yang
School of Information Sciences and Technology, The Pennsylvania State University

Amanda Spink
Associate Professor of, School of Information Sciences, University of Pittsburgh

Daniel Lorence
Department of Health Policy and Administration, And School of Information Sciences and Technology

ABSTRACT

This paper explores the conceptualizations of information, people and technology used by authors in the medical informatics research literature. Research articles in the relevant literature in applied medical informatics were classified. Also, when information and technology are viewed and analyzed from the viewpoint of organizational or social level, legal and ethical issues associated with them need considering.

I. BACKGROUND

A. Medical information systems

Medical information systems support clinical decision making. The exponential growth of medical information requires the increasing interaction and integration between people, information and technology. However, what is meant by information, technology and people (ITP) in the medical informatics research literature? How are ITP concepts discussed in medical informatics research articles published in the relevant medical informatics literature (e.g. JAMIA)? In this paper we first examine the conceptualization of ITP in the medical informatics domain. Second, the interrelations between ITP are analyzed at different levels of analysis. Third, the findings from our analysis are presented and discussed. Finally, the conclusions and their implications are provided.

B. Theoretical framework

Patient care has become increasingly complex with the widespread use of advanced technologies in routine medical care. Healthcare providers must track a staggering amount of information to provide effective patient care. Use of medical information systems by physicians improves the management of medical information. The traditional paper chart readily provides only about a third of the data that the physician needs while providing patient care. Medical information systems create an electronic patient record that facilitates the reporting, organizing, and locating of patient data.

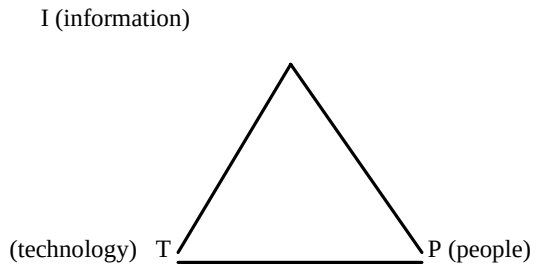
Much discourse around medical information systems research is structured by the interrelations among three constructs:

a. Information
b. Technology
c. People

The findings based on the analysis of the existing literature suggest that current scholarly discourse within medical information systems treats the above three constructs very implicitly. Usually they are regarded as a combination. And no article gave them an explicit position and meanings of and relations among ITP.

Three constructs— *information, technology and people* are key elements within the framework of medical information systems research and are widely used together in the current medical informatics research literature. Figure 1 shows the interrelationship between the three concepts.

Figure 1. The integration of information, people and technology.



This paper uses the broad meta-categories developed by Orlikowski and Iacono (2001) to analyze the medical information systems literature to determine how the concepts of information, technology and people are conceptualized, including: the *tool* view, the *proxy* view, the *ensemble* view, the *computational* view, and the *normal* view (Orlikowski and Lacono 2001).

A summary of Orlikowski and Lacono's approach is described as follows:

Tool view of technology represents the common, accepted wisdom about what technology is and means. For example, technology from this view is an artifact, a particular piece of equipment, application or technology which provides specifiable information processing capability.

Proxy view of technology represents the essential aspect or value of the information technology. The critical aspects of information technology can be captured through some set of surrogate measures — such as individual perceptions (perception view), diffusion rates (diffusion proxy) or dollars spent (capital proxy). Proxy view highlights the value of technology.

Ensemble view of technology represents a package which includes the components required to apply the technical artifact to some socio-economic activity. Ensemble view focuses on the dynamic interactions between people and technology —— whether during construction, implementation, or use in organizations or during the deployment of technology in society at large. There are four general forms of the ensemble view (Sawyer 2000): construction/implementation method, production network means, embedded system view and structure view.

Computational view of technology represents technology as algorithm or model. Algorithm view highlights computational concepts

This conference paper appears in the book, Innovations Through Information Technology, edited by Mehdi Khosrow-Pour. Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

and programming language. While model view focuses on creation, implementation and simulation of a computable model. Combination of both provides evidence by developing an artifact. Articles embracing this view are interested primarily in the capabilities of the technology to represent, manipulate, store, retrieve and transmit information.

Nominal view of technology represents technology as either incidental or used as background information. Technology is used in name only, not in fact. The characterization is implicit, presence or absence (Sawyer and Chen, 2000). Information is often needed immediately for individual patient care. Computer-based information systems, such as a personalized medical reference which aims to encapsulate essential medical knowledge, will become more generally available. The extent to which the contents of these are research based, however, will vary. Some may choose also to have MEDLINE or other databases on CD-ROM in the practice but will still need the services of librarians to enable them to learn effective searching strategies and to obtain documents.

III. METHODS

A. Data collection

The reviewed articles are selected from published in JAMIA (Journal of American Medical Association) for two reasons: first, JAMIA is the top journal in the medical informatics area. Second, the articles are representative, synthetic and comprehensive.

B. Data analysis

The level of analysis follows Sawyer and Chen (2000) - artifact, individual, group and institution.

The *artifact level* of analysis emphasizes a typical computational artifact.

The *individual level* of analysis pays attention to individual characteristics such as personal attitudes, beliefs, psychological attributes and cognition.

The *group level* of analysis focuses on work teams or small groups.

The *institution level* of analysis is used to represent social collection or organization which is larger than group. A multiple level of analysis is allowed in one study.

V. RESULTS

A. Information

Table 1 shows the distribution of the forty articles identified across three clusters on the conceptualization of information.

The cluster that is labeled the embedded view, accounted for 52.5 percent of all the forty articles published in JAMIA. It is also difficult to explicitly define the concept of medical information because information retrieval in medical domains differs from information retrieval in general domains. The barrier of developing a more explicit meaning lies in the difficulty and controversy on differences between data, information and knowledge (Brown and Duguid 1999; Taylor 1982).

Three main areas considered in the research literature were:

1.) The quality of the information;
2.) The cognitive value of the information;
3.) The value of the information in the decision making situation.

Information as a construct in medical information systems research was characterized in three ways: as object, as embedded or as naïve. From an object view, information is a discrete entity (Sawyer and Chen, 2002) which exists independently (Mcdonald, 1984; Lindberg, 1986). A second way to conceptualize information is as embedded into a larger entity (Sawyer and Chen, 2002) which is embedded in the organizational structure (Berner, 1999; Hunt, 1998; Kuperman, 1991; East, 1997).

The third is naïve view (Sawyer and Chen, 2002) from which the meaning of information is implicit. The most important elements in an impact study are whether the information actually makes a difference to the decisions made and whether it allows the recipient to advance the process more effectively. Therefore, papers related to clinical information systems involve at least two broad conceptualizations of medical information: as object and as embedded in an organizational structure.

Table1. Classification of articles by conceptualization of information.

Cluster	*Conceptualization of Information*	*Freq.*	*%*
Object view	Discrete entity	13	32.5%
Embedded view	Embedded in the systems	21	52.5%
Naïve view	Implicit meaning	6	15%
Total		40	100%

Table2. Classification of articles by conceptualization of information technology.

Cluster	*Conceptualization of Technology*	*Freq.*	*%*	*Freq.*	*%*
Nominal view	Absent	3		3	7.5
Computational view	Algorithm	1		11	27.5
	Model	9			
Proxy view	Perception	1		2	5
	Diffusion	0			
	Capital	1			
Tool view	Labor Substitution Tool	1		15	37.5
	Productivity Tool	3			
	Information processing Tool	10			
	Social relations Tool	1			
Ensemble view	Development Project	1		9	22.5
	Production Network	2			
	Embedded system	5			
	Structure	2			
Total		40		40	100

B. Technology

Based on the forty articles published in JAMIA, I explored the conceptualization of technology and its influence on the understanding of the nature and role of technology in organizational and socio-economic practices.

Table 2 shows the distribution of the 40 articles across the 14 categories and 5 clusters. The cluster, which is labeled the tool view, accounted for 15 percent of all the 40 articles published in JAMIA.

As evident in Table 3, tool view of technology is the dominant view as a tool for data retrieval, data evaluation, accessing and presentation.

I found that the tool view was represented in the medical information systems literature in four different ways:

- Technology as a tool for labor substitution. Technology would substitute for and replace labor, which enables organizations to work more cheaply and efficiently.
- A tool for enhancing productivity.
- A tool for information processing. An alternative "tool view" argued that what technology does best is to alter and enhance the ways that humans and organizations process information.

And a tool for changing/improving social relations. Technology can and does alter social relations.

1) Technology as a tool for labor substitution.
Technology would substitute for and replace labor, which enables organizations to work more cheaply and efficiently. Sailors describes the "tool" view of information technology as :"Computers serve as information repositories which allow quick and accurate data review, and physiologic models to help plan care and help in patient care by directing or critiquing therapies, plans and orders" (Sailors and East, 1998). Computer-based implementation has improved the cost-effectiveness of clinical practices (Greenes & Boxwala, 1998). Rolf argues that hospital information systems management focus on IT and especially Electronic Patient Record (EPR) as a tool for changes that will lead to a better economy as well as better quality and service to the patients (Rolf, 1999). Overall, computers behave like human beings. Hence, cost and labor are saved.

Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

2) A tool for enhancing productivity
Machado mentions in his article that one of the goals of applying information systems in medicine is to uncover new relations among data and reveal new patterns that identify diseases, determine prognoses, or indicate certain treatments (Ohno-Machado and Fraser, 1998).

3) A tool for information processing
An alternative "tool view" argued that what technology does best is to alter and enhance the ways that humans and organizations process information. The use of machine learning and related statistical models for medical applications has experienced an enormous growth in the past decade. A machine learning resource is clinical data processing tools (Ohno-Machado and Vinterbo, 1998).

4) A tool for changing/improving social relations
Technology can and does alter social relations. Computer-based clinical decision support systems are often implemented at the level of aggregates of healthcare providers or teams such as physicians, ward teams or outpatient practices (Randolph and Haynes, 1999, Friedman and Wyatt, 1997, McDonald, 1984). Rolf argues that the implementation of IT leads to changes in organization structure and workflow.

C. People

We identified three conceptualizations for people in the medical informatics research literature.

1.) Health care professionals:
I. Improve health care (Aronsky, 1999; Hammond, 1999; Hunt, 1998).
II. Improve our understanding of public health and the ways new knowledge that can be derived from information regarding popula tion of patients) (McDonald, 1984; Delone, 1992; Randolph, 1999).

2.) Patients (people who benefit from and use systems) (Hunt, 1998; McDonald, 1984)

3.) Systems designers and developers:
I. Enhance the quality of imaging modalities, II. Interpret complex data) (Carlson, 1995; Berner 1999; Kuperman 1991).

The conceptualization of people is given in the range of the medical discipline. Here, people presented in the literature might focus on individual attributes of a person. But in the clinical domain, the organizational characteristics of people are likely to be depicted. There are totally three forms of characterizations of people as a construct in medical information systems research (Sawyer and Chen, 2000). The first characterization of people is individual attributes. The second is social: as aggregations or collectives in which collective attributes and behaviors of people are central. The third is called naïve where grounded theoretical base is absent.

This classification of people provides a means to discriminate and analysis people who are depicted in current medical information research literature. Analysis related to people should be on the level of group or beyond.

Table 3. Literature summary

Form	Tool (Feature)	Proxy	Ensemble (Function)	Proof of concept	Presence/Absence
N= 40	9	2	21	4	4
Information	Object	Naïve	Embedded Naïve	object	Naïve
People	Individual Social	Naïve	Individual Social	Social & naïve	Individual & social
Level of Analysis	Group & individual	Individual & institutional	Institutional	system	?
Research Method	Case & experiment	Field & case	Field	Model & algorithm	?

D. Integrated approach

Table 3 summarizes the findings of the medical information systems literature. The findings by analyzing the literature resource are presented as follows:

IV. DISCUSSION

A. Tool view

The *Tool view* is the dominant view of medical information systems and the largest cluster within the research literature. At present, research has been converging on more effective and accessible tools for clinical decision making .This has occurred in two areas:

I. The development of tools for primary decision making.
II. The development of authoring environments and models that facilitate the construction of decision support materials.

Some work in decision support tools is involved in the application of machine learning techniques in the context of tools for predicting outcomes. For example, in determining prognosis for individual patients with specific types of spinal cord injury, based on analysis of stored outcomes data (Lucila, 1999; Goodwin, 1999). The next generation of computer systems will have to include, if they are to have a significant impact on the quality of patient care: data acquisition, data storage, information display, data processing, and decision support (Sailors and East, 1998).

B. Computational view

The second largest cluster of medical information systems articles is the group of articles is labeled as taking a *computational view* of the technology. Not all research in the field of medical information systems is interested in the interaction of people with technology in various social contexts. Some research concentrates specifically on the computational power of information technology. Articles embracing this view are interested primarily in the capabilities of the technology to represent, manipulate, store, retrieve, and transmit information, thereby supporting, processing, modeling, or simulating aspects of the world. For example, Hogan and Wagner (1999) described a belief-network explanation algorithm and then built a program to implement it in clinical event monitors, one of medical expert systems that rely on the clinician to take action in the care of patients in order to have a beneficial effect on patient care, and test it (Hogan and Wagner, 1999).

Recently, more and more researches are concerned with the application of statistical methods and machine learning models in the prediction and recover outcome of diseases such as spinal core injury, heart disease, cancers and so on (Robin, 1999).

c. Ensemble view

The third largest cluster within information technology of medical information literature is represented by the *ensemble view* at 22.5 percent of the article. Ensemble view (multiply technologies interacting, for example, production medical network——the interactivity of technology builders.) can be another view. Embedded technology tied very closely to its social use, medical information system demands the integration of people, information and technology. Decision Support Systems develop in an organizational context.

D. Nominal view

Those articles that are grouped under the nominal view represent the *fourth largest cluster*. Accounting for 7.5 percent of the total set of articles, this cluster is characterized by treating technology as absent, referring to it in passing, as the context, motivation, or background.

E. Proxy view

The *fifth largest cluster* of ISR articles is represented by a proxy view of information technology, where one or a few abstracted elements are focused on and assumed to represent the critical aspects of the technology. This cluster represented 5 percent of the articles published in the medical information systems area. The proxy view of technology represents the essential aspect or value of the information technology.

Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

The critical aspects of information technology can be captured through some set of surrogate measures — such as individual perceptions (perception view), diffusion rates (diffusion proxy) or dollars spent (capital proxy).

The proxy view highlights the value of technology. Seen from an economic perspective, there is a shift from PPR i.e. paper based patient records to EPR, i.e. electronic based patient records (Rolf, 1999). Nikula mentioned that:" it is obvious that shifting the medium makes it possible to simplify the routines concerning the patient record, no more looking around for patient-related information, the physician can countersign her notes form almost anywhere, and we can one day close down or phase out the archives. However, at the same time new expenses emanate. The new costs must cover among other things: hardware, application, application training and so on (Nikula, 1999). Rolf mentioned: "the costs in healthcare derive from decisions made by clinicians. A patient, placed in a hospital bed without any further actions taken will merely cost a small sum of money as a " hotel guest" (Rolf,1999).

In sum, technology is never merely and automatically just an object. It is always and already implicated in action and effect (Grint & Woolgar, 1995). Because IT artifacts are designed, constructed, and used by people, they are shaped by the interests, values and assumptions of a wide variety of communities of developers, users, etc. IT artifacts are always embedded in some time, place, and organization. IT artifacts become interdependent with socio-economic contexts and practices. Therefore, separating information and technology from people would be invalid and fruitless. Historical and cultural aspects of IT development and use also can not be ignored, especially associated the legal and ethical issues in the medical domain. For instance, the confidentiality and privacy issues of patients are critical in the field of clinical practice.

In summary, a review of the medical information systems articles published in JAMIA reveals a broad array of conceptualizations of information, technology and people. It seems that technology still could be viewed relying on the general conceptualization of the technology through special disciplinary lenses —— the medical domain. Clinical information researchers publishing in the Journal of American Medical Information tend to abstract IT artifacts from an artifact, a particular piece of equipment, application or technology which provides specifiable information processing capability. Therefore, the conceptualizations of information, people and technology is not only possible, but essentially important to make understanding of the medical information world which becomes increasingly interdependent with ubiquitous, emergent, and dynamic technology.

In addition, the articles reveal that the changes in politicians and hospital management on IT, in another word, the changes in the organization structure and workflow of people lead to better economy as well as better quality and service to the patients. These changes are not direct effects on patients but indirect effects due to the possibilities embedded in the new technology. Individuals and groups participate in and make an implementation process of medical information systems powerful. For instance, in Rolf paper, he mentioned: "To be able to realize the possibilities embedded in the EPR as a technology the implementation has to induce organizational changes." "With the EPR we attempt, for the first time, to implement IT into the core processes of health care i.e. the process that generate the costs. Hence it is of outmost importance that the changes are induced by the clinicians themselves. Also the organizations' abilities to make inquiries and analyses of the actual organization and working procedures become important."

Computer-based clinical decision support systems are often implemented at the level of aggregates of health care providers of teams such as physicians, ward teams, or outpatient practices. For example, in the study by Mcdonald et al, 27 practice teams were randomly allocated to CDSSs or control services (Mcdonald, 1984). All patients of any one practice team were automatically allocated to the same arm of the study. In this case, groups of patients in each team can be called clusters. Therefore, it is suggested to study clinical support systems interventions at group or beyond level for several practical reasons, including the need to implement systems at group/ cluster level, the need to avoid control group contamination and cost-effectiveness. However, the review indicates that the methodological issues associated with group/ cluster design in clinical support systems are not recognized very well by medical informaticians.

The research in medical information systems is not rooted in a single theoretical perspective. The research approaches we have discussed above do offer an insightful perspective on the phenomena of interest in medical information systems. A single research perspective for studying information systems phenomena is unnecessarily restrictive. And urge that there exist other assumptions and perspectives that can inform studies of the relationships between information technology, people and organizations in medical information systems domain.

V. CONCLUSION

The interaction between people, computer and systems need to improve adaptability to meet the efficiency of decision making. By reviewing the literature in the medical information systems area, it is suggested that the above presented research perspectives and approaches are effectively employed to investigate medical information systems.

REFERENCES

Alto J. Automated Collection of Infusion Pump Data: Nurse Utilization and Its effects on Clinical Data. Dapartment of Medical Informatics. Salt Lake city: University of Utah, 1997.

Berner ES. Clinical Decision Support Systems: theory and practice. New York: springer-verlag, 1999.

Carlson D, Wallace CJ, East TD, Morris AH. Verification and Validation Algorithms for Data Used in Critical Care Decision Support Systems .In: Gardner RM, ed. Proceedings of the 19th Annual Symposium on Computer Applications in Medical Care. Philadelphia: Hanley & Belfus, Inc., 1995.

Cole WG. Metaphor graphics and visual analogy for medical data, Symposium on Computer Applications in Medical Care, Washington, DC, 1987, AMIA.

Delone, W.H. & E.R. Mclean (1992). Information systems success: the quest for the dependent variable. Information Systems Research 3, March, pp. 60-95.

East T, Salors R. Clinical Information systems in critical care. Clinical information systems. Redmond, WA: spacelabs Medical Inc., 1997.

Hammond J, Johnson HM, Varas R, Ward CG. A qualitative comparison of paper flowsheets vs a computer based clinical information system. Chest 1991; 99:155-157

Hunt DL. Haynes RB, Hanna SE, Smith K.Effects of computer-based clinical decision support systems on Physician performance and patient outcomes: a systematic review.JAMIA 1998 Oct 21: 280(15):1339-46.

Kuperman GJ, Gardner RM, Pryor TA: HELP: a dynamic Hospital Information system. New York: Springer – verlag, 1991.

Shabot MM. Cedars-sinai ICU decision support tools, 1996

Randolph AG, Haynes RB, Wyatt JC, Cook DJ, Guyatt GH. Users'guides to the medical literature: XVIII. How to use an article evaluating the clinical impact of a computer-based clinical decision support system. JAMIA 1999; 282: 67-74.

Friedman CP, Wyatt JC. Evaluation methods in medical informatics. NY: Springer-Verlag; 1997.

McDonald CJ, Hui SL, Smith DM. Reminders to physicians from an introspective computer medical record. Ann Intern Med. 1984; 100:130-138.

D.L. Rubin, J.H. Gennari. Tool support for authoring Eligibility Criteria for cancer trials. JAMIA, 1999, Page 369-370.

W.R. Hogan, MD. MS, B. Dasgupta, MS. The use of an explanation algorithm in a clinical event monitor. Journal of American Medical Association, page: 281-284.

Grint, K., S. Woolgar.1995. On some failures of never in constructivist and feminist analyses of technology. Sci. Tech., Human Values 20(3) 286-310

Lindberg DAB, Schoolian HM. The National library of Medicine and medical informatics . West J Med 1986; 145: 786-790

Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

Forsythe DE, Buchana BG, Osheroff JA, Miller RA. Expanding the concept of medical information : an observational study of Physicians' information needs. Compution Biomed RES 1992; 25:181-200

The institute of Medicion, The computer based patient record: An essential technology for Healthcare," edited by R.S Dick and E.B. Steen, National Academy Press, Washington; 1991

Myers D, Culp K and Clark G:perspective on the development of an electronic medical record system for practice of medicine. Proceedings of the 8th Annual International Sysposium on computerization of Medical records. 1992 March 4-7: new Orleans, La.P.22-25

Myers Dl, culp KS, Miller RS and Clark G: representation, access and utilization of clinical information on psychiatric patients in large data base. Symposium program of advanced informatics in medicine.

Cimino jj; Socratous SA; Clayton PD: Internet as clinical information system: application development using the world Wide Web .Jam Medi Information Assoc, 1995 sep, 2:5, 273-84

Dominik Aronsky, MD and peter J.Haug, MD: An integrated decision support system for diagnosing and managing patients with community-acquired pneumonia. Journal of Medical American Association, 1999.

Lucila Ohno-Machado, M.C., PPh.D.Staal Vinterbo: Clinical data processing tools: a machine learning resource. Journal of American Medical Association, 1999.

Deborah. K.W. Walters, Ph.D. Richard T. Linn, Ph.D.: Selecting Modeling techniques for outcome Prediction: comparison of Artificial neural networks, classification and regression trees, and linear regression analysis for predicting medical rehabilitation outcomes. Journal of Medical American Association, 1999.

Peter J.Porcelli, MD and David F. Lobach, MD, PhD, MS: Integration of clinical decision support with on-line encounter documentation for well child care at the point of care. Journal of American Medical Association, 1999.

Jen-Hsiang Chuang, M.D., M.S., George Hripcsak, M.D., M.S.: Considering clustering: A methodological review of clinical decision support system studies. Journal of American Medical Association, 1999.

McDonald CJ, Hui SL, Smith DM. Reminders to physicians from an introspective computer medical record. Ann Intern Med. 1984: 100: 130-138.

Fu Zhao, B.Eng. and Tze-Yun Leong, Ph.D: A data preprocessing Framework for supporting probability-learning in dynamic decision modeling in medicine. Journal of American Medical Association, 1999.

Robert A. Greenes, MD, PhD: A framework and tools for authoring, editing, documenting, sharing, searching, navigating, and executing computer-based clinical guidelines. Journal of American Medical Association, 1999.

LK. Goodwin, SG. Maher, MA. Iannacchione, PACrockett WE.: new data mining tools for outcomes analysis in complex clinical problems. Journal of American Medical Association, 1999.

Lucila Ohno-Machado, M.D., M.H.A., Ph.D.: Improving machine learning performance by removing redundant cases in medical data sets. Journal of American Medical Association, 1999.

R. Matthew Sailors, Ph.D. and Thomas D. East, Ph.D.: Clinical informatics: 2000 and beyond. Journal of American Medical Association, 1999.

Lucila Ohno-Machado, M.D., Ph.D. Staal Vinterbo, M.Sc.: Clinical data processing tools: a machine learning resource. Journal of American Medical Association, 1999.

Lucila Ohno-Machado and Donald Bialek: Diagnosing breast cancer from FNAs: variable relevance in neural network and logistic regression models. Journal of American Medical Association, 1999.

Nikula, Rolf E., MI, Ph.D.: Organizational and technological insight as important factors for successful implementation of IT. Journal of American Medical Association, 2000.

Dominik Aronsky, MD and Peter J.Haug.MD. An integrated decision support system for diagnosing and managing patients with Community-Acquired pneumonia. Journal of American Medical Association, 1999.

Steve Saywer, Tina T.Chen: conceptualizing information technology in the study of information systems: trends and issues. in Myers, M., Whitley, E., Wynn, E. and DeGross, J. (Eds.) Global and Organizational Discourse About Information Technology, London: Kluwer, in press.

Wanda J. Orlikowski, C. Suzanne Iacono: research Commentary: desperately seeking the "IT" in IT research —— A call to theorizing the IT artifact. Information Systems Research, 2001: pp. 121-194.

Copyright © 2004, Idea Group Inc. Copying or distributing in print or electronic forms without written permission of Idea Group Inc. is prohibited.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/proceeding-paper/conceptualization-information-people-technology-medical/32442

Related Content

Hybrid Genetic Metaheuristic for Two-Dimensional Constrained Guillotinable Cutting Problems
Hamza Gharsellaouiand Hamadi Hasni (2015). *Encyclopedia of Information Science and Technology, Third Edition (pp. 163-174).*
www.irma-international.org/chapter/hybrid-genetic-metaheuristic-for-two-dimensional-constrained-guillotinable-cutting-problems/112326

Decimal Hardware Multiplier
Mário Pereira Vestias (2018). *Encyclopedia of Information Science and Technology, Fourth Edition (pp. 4607-4618).*
www.irma-international.org/chapter/decimal-hardware-multiplier/184168

Application of Improved Sparrow Search Algorithm in Electric Battery Swapping Station Switching Dispatching
Qingsheng Shiand Feifan Zhao (2023). *International Journal of Information Technologies and Systems Approach (pp. 1-21).*
www.irma-international.org/article/application-of-improved-sparrow-search-algorithm-in-electric-battery-swapping-station-switching-dispatching/330421

BitTrace: A Data-Driven Framework for Traceability of Blockchain Forming in Bitcoin System
Jian Wu, Jianhui Zhangand Li Pan (2024). *International Journal of Information Technologies and Systems Approach (pp. 1-21).*
www.irma-international.org/article/bittrace/339003

Information Visualization Based on Visual Transmission and Multimedia Data Fusion
Lei Jiang (2023). *International Journal of Information Technologies and Systems Approach (pp. 1-14).*
www.irma-international.org/article/information-visualization-based-on-visual-transmission-and-multimedia-data-fusion/320229