Medical Informatics Europe '96
J. Brender et al. (Eds.)
IOS Press, 1996

329

Evaluation of Clinical Workstations

Karin HOFMANN, Stefan GRÄBER
Institute of Medical Biometrics, Epidemiology and Informatics
Monika FLAIG
Department of Internal Medicine V (Pneumology)
University of Saarland
D-66421 HOMBURG, Germany

Abstract. The University Hospital of Saarland plans to equip all wards with clinical workstations. Therefore we started tests with two different commercial systems to evaluate their advantages and disadvantages in our environment. We compiled a list of required functions and developed a grading system for the assessment of the functionality. In this paper we present the grading scheme and discuss the results of the evaluation.

1. Introduction

Although - due to the development of comfortable user interfaces - more and more computers are used for clinical purposes in hospitals, there are different opinions about the necessary functions and the intended purpose of these computers. We register various terms: in the USA one calls them "Patient Care Information System" [1] or "Clinical Workstation" [2], in Germany we find "Medical Workplace System" [3], "Ward System" [4] or "Electronic Patient Record" [5]. Regarding their conception and their range of functions they are often stand-alone solutions, which only cover some isolated aspects (e.g. collecting, storing, and presenting of vital signs, information services for physicians, or nursing documentation).

First of all the conception of a hospital information system must take into consideration the clinical features [6]. We do not only want to link the stand-alone solutions with one another but also - especially for the wards as the most important units in the medical care of in-patients - to provide a complex integrated system. We define clinical workstations as software systems supporting physicians and nurses in all their specific activities concerned with the medical care of in-patients [4].

2. Criteria and Scores

Both the development and the selection of software demand as detailed a description as possible of the required functionality of clinical workstations. For the evaluation of systems on offer we developed a list of criteria for four groups. The first group includes the functions to support the physicians, the second the functions to support the nurses, the third general functions, and the fourth the system environment. In this context we ignored the surgical field (i.e. documentation of operations); we consider it to be a special function unit which needs its own documentation system [4].

Table 1: List of criteria: functions

Functions to support physicians
Documentation
Anamnesis
List of allergies and risks
Images / Sounds / Pictographs
Findings
Views to the electronic patient record
Diagnoses
Treatments
Coding helps (e.g. for ICD)
Medical reports
Statistical analyses
Use of patient's documentation as knowledge base
Decision support
Organization
Prescriptions
Orders for external services
Therapy plan
Scheduling
Information services

Functions to support nurses
Documentation
Nursing care plan
Anamnesis
Problems and resources
Objectives
Interventions
Controlling
Evaluation
Nursing reports
Vital signs
Recording
Graphical presentation
Statistical analyses
Organization
Scheduling
Bed management
Distribution of drugs and infusions
Orders to pharmacy
Orders to materials management

General functions	
Access to administrational patient data	Integration of other programs (e.g. spreadsheet)
Registration of services	Rota planning

Table 2: List of criteria: system environment

Internal communication	Data protection
External communication	Data collection
System administration	Masks
Configuration	Forms
User interface	Free text
Masks	Mobile data collection
Navigation	Printing facilities
Unified terminology	Response times
User levels (Beginner → Expert)	Failure times
Input devices	Labor saving
Mouse	Help
Notepad	Program documentation
Bar-code	General on-line help
Other input devices	Context-sensitive on-line help
Data security	After-sales support

Table 3: Grading criteria

Scope	Score
Not supported	0
Announced for next release	1
Supported, not configurable	2
Supported, user-configurable	3

Quality	Score
Not sufficient	0
Sufficient	1
Good	2
Very good	3

Weight	Value
Needless	0
Useful	1
Important	2
Very important	3

To save space the list (table 1 and 2) is limited to the main criteria. In practical use some criteria are considered in much more detail (e.g. the items "nursing care plan" or "user inter-face").

We evaluate the scope and the quality of each function taking a weighting system into account. The score range is 0 to 3 (table 3). To grade the quality of a function it must at least exist. Some functions offered by the clinical workstations can not be scored in our environment. In such a case the quality is considered not to exist. Afterwards we multiply each score by its appropriate weight to get the final score for one function. Group scores are built by adding up the function scores. We end up with eight individual scores describing the offered scope and quality (e.g. see table 4, bold figures in columns 2 and 3).

There are of course some features such as hardware and software prerequisites, database management system, necessary reorganization of workflows etc. which do not fit into the grading scheme described here. If necessary, these features have to be considered in a final decision in a more general way because of the difficulty of using scores to evaluate them.

This concept allows the grading to be done as far as possible by the ward staff (physicians and nurses) with the assistance of the system administrator involved.

3. Application

Two commercial systems have been tested in the University Hospital of Saarland, the product MediCare by MICOM and the product SC-MED by SOFTCON. Neither product covers all mentioned functions but both are suitable for use as clinical workstations. They have a wide range of functions and can be customized.

The product MediCare runs on personal computers with NOVELL NetWare and MICROSOFT Windows. As a special feature notepads for mobile data collection can be used. The underlying database is MICROSOFT Access. The test is being carried out on a ward covering internal medicine (gastroenterology and endocrinology).

The product SC-MED runs on a UNIX server (HP-UX, System V) using the window system OSF/Motif. The data is stored in a relational database (here: ORACLE). The server is integrated in a LAN. Personal computers with X-emulation are used as workstations. Mobile data collection is not planned at present. SC-MED is being tested on a ward covering internal medicine (pneumology).

The validity of our evaluation might be considered restricted since only one ward is involved per system and each has a different set of patients. However, many of the criteria are independent of ward details so that the figures derived will provide a useable base for system assessment.

4. Results and Discussion

We compared the two systems using the described grading scheme. The final result (table 4, for more details see [7]) shows that SC-MED comes off better than MediCare in all groups. The essential functions (table 1 and 2) are covered by both programs. The support by the system administrator as well as the vendor support for SC-MED was better than for MediCare. The potential benefit of MediCare by using notepads for the bedside documentation could not be proved (see below).

Several conditions influenced the evaluation using the grading scheme. In the following we discuss the most important problems.

In changing from conventional methods of paper-based documentation to computer-based documentation it is often necessary to rearrange the workflow. This leads to organizational problems like the necessity of the integration of the computer in daily routine. There must be enough computers at suitable positions and both the physicians and the

nurses must use the computer to input data and to look for it. When the clinical worksta-
tions were introduced on the two wards a large number of the ward staff had to work with
computers for the first time. They did not know how to turn on a computer or a printer or
how to feed paper. Furthermore they were insecure because of a great fear of making mis-
takes and their ignorance about the possible reactions of the program. Reluctance to use
computers is wide spread although the new way of documenting generally provides better
availability and faster access [1].

Table 4: Summary of results

	MediCare		SC-MED	
	Scope	Quality	Scope	Quality
Functions to support physicians				
Documentation	*83*	*46*	*163*	*110*
Organization	*23*	*12*	*25*	*12*
Total	**106**	**58**	**188**	**122**
Functions to support nurses				
Documentation	*76*	*66*	*102*	*69*
Organization	*46*	*27*	*40*	*37*
Total	**122**	**93**	**142**	**106**
General Functions	**24**	**19**	**56**	**28**
System environment	**162**	**82**	**193**	**165**

A very important feature for clinical workstations is the ease of customizing. Since dif-
ferent specialties have different requirements in addition to the structural configuration
(staff, rooms, ...) both systems offer customization of the documents, forms and list of
nursing standards used. Therefore the various document types (nursing report, findings,
reports of examination, ...) of each specialty must be analyzed separately to derive the con-
figuration data required by the programs. The manufacturers support this task by giving
suitable examples.

Because neither the central laboratory nor the central kitchen are endowed with computer
systems allowing data transfer between the clinical workstations and themselves, we could
not test and compare the external communication with them. However, we have connected
one external function unit to each system, for MediCare the function unit endoscopy, for
SC-MED the unit for pulmonary functions tests. Special interfaces were developed to trans-
fer the administrational patient data from the patient management system to the clinical
workstation using a dedicated communication server [8].

Another problem has been that a new nursing model was introduced just before our test
started. The theoretical basics of the nursing process had been conveyed in a course of
training. At the same time standards for the nursing process were developed by a work-
group. This has led to frequent changes in the configuration of the clinical workstation.

Both programs offer appointments facilities for the external function units. The use of
the electronic appointments book is easy and comfortable. The ward staff can look at the
appointments book which shows them busy and free dates but no details of any patient from
other wards. They register their requirements, giving their preferred dates, with the function
unit which confirms a date or offers an alternative. The change from the conventional kind
of scheduling by phone calls and appointments book to an electronic appointments book is
regarded with skepticism by both ward staff and function unit staff: if they have a very tight

schedule because of emergency patients or unexpected out-patients the involved wards must be informed that the appointment must be changed. In practice an adequate response is often impossible. This example shows the discrepancy between feasibility as far as a program is concerned and feasibility as far as a an organizational structure is concerned.

Mobile data collection with notepads (MediCare), for instance during the doctor's visit, has proved a failure because the display was too small and the processor used was too slow. All the data has to be collected afterwards at the workstation. Physicians and nursing staff agree that mobile data collection and presentation, using suitable equipment, would make daily clinical work a lot easier. This agrees with experiences by other authors [9]. In this context we emphasize that data protection is a serious problem because the patient data remain on the notepads and these are not theftproof.

5. Conclusions

In our opinion neither of the two products has an adequate degree of sophistication at the moment. Therefore the consequence of our experiences is that we are investigating the application of features offered by the hospital information system [4,7]. We want to establish a partial solution on the wards, i.e. to begin with a basic set of functions - e.g. access to patient administration system or medical documentation - and to add the remaining functions step by step.

We plan to equip all 85 wards of the University Hospital of Saarland uniformly and link them to the hospital communication network. As a result of connecting all wards and all function units to the network we expect a positive effect for the hospital. Reports on the benefits of information systems [4,10] also show that the acceptance of clinical workstations depends on the scope of the features offered. Our experiences and the nursing workgroup results will be relevant for future activities.

References

[1]   E.L. Drazen *et al.*, Patient Care Information Systems. Springer, New York, 1995.
[2]   J.E. Hammond *et al.*, Report on the clinical workstation and clinical data repository utilization at UNC Hospitals, *Proc-Annu-Symp-Comput-Appl-Med-Care*, 1994, 276-280.
[3]   A. Lagemann *et al.*, Konzept und Realisierung eines Medizinischen Arbeitsplatzsystems. In: S.J. Pöppl, H.-G. Lipinski, T. Mansky (Eds.), Medizinische Informatik. ISBN: 3 820 81232 6. MVV Medizin Verlag, München, 1994, 120-123.
[4]   S. Gräber, D. Geib, Rahmenkonzept für ein Klinik-Informations- und -Kommunikations-System in den Universitätskliniken des Saarlandes. Universitätskliniken des Saarlandes, Homburg, 1994.
[5]   D. Hölzel *et al.*, Die elektronische Krankenakte. ISBN: 3 609 64470 2. ecomed Verlagsgesellschaft, Landsberg, 1994.
[6]   G. Griesser, Ein Krankenhaus-Informations- und Kommunikationssystem zur Unterstützung der Klinik. ISBN: 3 88312 090 1. Gesellschaft für Systemberatung im Gesundheitswesen mbH, Kiel, 1994.
[7]   K. Hofmann, S. Gräber, M. Flaig, J. Klein, Evaluation von Stationssystemen. Universitätskliniken des Saarlandes, Homburg, 1996.
[8]   S. Gräber, Erfahrungen mit einem kommerziellen Kommunikationsserver. In: P. Haas *et al.* (Eds.), Praxis der Informationsverarbeitung im Krankenhaus. ISBN: 3 609 51050 1. ecomed Verlagsgesellschaft, Landsberg, 1996.
[9]   K.E. Dennis, P.M. Sweeney, L.P. Macdonald, N.A. Morse, Point of Care Technology: Impact on People and Paperwork, *Nursing Economics* **11(4)**, 1993, 229-237, 248.
[10] H.U. Prokosch, J. Dudeck, Evaluation der Akzeptanz eines Krankenhaus-Informationssystems bei den ärztlichen Mitarbeitern eines Universitätskrankenhauses, *Informatik, Biometrie und Epidemiologie in Medizin und Biologie* **26(2)**, 1995, 107-120.