Integration of a handheld based anaesthesia rounding system into an anaesthesia information management system

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KEYWORDS
Mobile data collection; Handheld; PalmOS; Anaesthesia Information management system; Preoperative rounds

Summary
Background: At the University Hospital Giessen, an anaesthesia information management system (AIMS) is used for online record keeping of perioperative patient care, but preoperative anaesthesia assessments were still being recorded on paper and subsequently entered into the AIMS. Personal digital assistants (PDAs) seem to be useful instruments to establish a seamless digital anesthesiological documentation.

Objectives: We decided to implement a solution for direct integration of data gathered during the preoperative assessment into the existing data management infrastructure. Parallel to the development of the system, we surveyed the future users to match their wishes and needs as far as possible.

System description: A C program embedding the preoperative AIMS’ data fields was developed. Data alignment with the Hospital Information system (HIS) is controlled by a Java desktop software. The anaesthesiologist completes the available fields at the patient’s bedside following the same algorithm and integrity check as the PC version.

Status report: Overall, 68% of the surveyed physicians supported the implementation of the system. The PDA solution has been available since May 2002. Data replication into the handheld and integration of mobile collected data into the AIMS generally work without problems. The HIS interconnection software converts the PDA file into the AIMS format for further processing.

Discussion: The preoperative anaesthetic assessment is a standardised task well suitable for conversion to an electronic data storage medium. Changing from redundant data entry in the OR to direct electronic recording at the patient’s bedside seems simply logical. Handheld computers are inexpensive, flexible gadgets to realize this.

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1. Introduction

The use of anaesthesia information management systems (AIMS) is spreading increasingly, replacing conventional paper records. With the help of these systems, the needs for allowing a bidirectional flow of information at the anaesthesia work station as well as increasing requirements for medical, administrative and medico-legal purposes in anaesthesiology can be met better [1—6].

At the University Hospital Giessen, an AIMS has been routinely used for online record keeping of perioperative patient data since 1995. This system electronically records all patient data during anaesthesia including the preoperative assessment as well as preoperative and postoperative care in the recovery room. More than 130,000 anaesthesia records have been stored since 1997. The AIMS has proved itself reliable in clinical routine and as a tool for research [7—11].

Despite being readily available within the AIMS and being the only data not yet integrated into the system, preoperative anaesthesia assessments were still being recorded on paper by physicians. Whereas anaesthesia records are usually recorded at defined, networked anaesthesia workstations, the preoperative round is often conducted at the patient’s bedside, the ambulatory ward and other locations, thereby requiring mobile data recording facilities. In these settings, personal digital assistants (PDAs) seem to be useful. Compared to desktop computers, these palm-size computers called handhelds are a more recent addition to the hardware market. The first PalmOS based handhelds were introduced in March 1996. Ever since, these and similar devices have spread widely, with about 10 million PDAs selling worldwide last year.

The introduction of handhelds in health care has been rather hesitant, even though recent publications document increasing interest in these small sized mobile computers [12—19].

2. Background

2.1. Preoperative anaesthesia assessment

Medical documentation is an intrinsic part of a doctor’s responsibilities and basic commitment to the patient. Documentation is compulsory and part of medical professional rules. Following the guidelines of the German Society of Anaesthesiology and Intensive Care Medicine (DGAI) [20], the preoperative assessment includes the patient’s medical history, physical examination and evaluation of existing diagnoses. Additionally, the data set of the DGAI for quality assessment must be completed [21,22]. The majority of these data relates to the patient’s preoperative condition and is routinely recorded during the anaesthesia rounds.

In order to obtain detailed information of the patient’s condition, the anaesthesiologist records the patient’s history according to the above-mentioned criteria. He refers to the patient’s file while at the same time obtaining additional information from the patient. In Germany, the use of standardised patient questionnaires and letters of consent have become standard. These structured sheets contain questions about organ systems and existing diseases. Besides a physical examination (check list), these sheets also provide a description of the anaesthetic procedure including typical risks in laymen’s terms. The sheets are usually administered before the doctor’s rounds by the ward staff and are intended for patient information and preparation, leaving a copy with the patient.

During preoperative rounds, the anaesthesiologist transfers relevant diagnoses to a premedication record along with instructions to the ward’s personnel about scheduled examinations and medication on the day of surgery. This preoperative record is part of the anaesthesia record and accompanies the patient to the operating room for the attending anaesthesiologist.

2.2. Functions of the AIMS

The AIMS (NarkoData, IMESO GmbH, Huettenberg, Germany) records relevant aspects of anaesthesia care, from patient admission to the operating room or the anaesthesia day-care unit (in case of ambulatory surgery) to discharge from the recovery room or PACU. Patient demographics and laboratory data are imported from the hospital information system (HIS) and are supplemented by automatically imported data from previous procedures and anaesthesia assessments. Data from respirators and vital-sign monitors are gathered automatically at defined intervals where compatible device interfaces are available. Additionally, data from the data set for quality assurance projects of the DGAI [21,22], the ASA physical status and other scores (e.g. Mallampati classification, Glasgow Coma Scale, Aldrete score, etc.) can be recorded via preconfigured choice lists. If the diagnosis of an organ system is judged to be "pathologic", further details have to be added in a sub-window either by using selection lists or as free-text entry. These defined sub-fields are subjected to strict logical algorithms excluding non-logical combinations of relevant diagnoses (Fig. 1).
Fig. 1 Logic check in the anaesthesia record, showing pre-configured fields for the organ system "heart". Only one degree of severity of heart failure can be selected—here NYHA III. Upon choosing a field, all other non-logical fields turn grey and cannot be selected.

The relevance of the diagnosis for anaesthesiology has to be assessed for each organ system. If information is missing (e.g. emergency patients or examinations not carried out), the field "no information available" (score 0) can be selected. An automatic integrity check of all mandatory fields is carried out within the program application informing the user about empty entries and/or missing information.

Since implementation of NarkoData version 4, direct recording of all data taken during the preoperative rounds, including a print out with instructions to the ward’s staff, had been possible. All data of the patient’s preoperative condition can be made available directly to the anaesthesiologist in the operating room.

Upon closure of the anaesthetic record after discharging the patient, all information is imported into a relational database (Oracle 7, Oracle Corp., Redwood Shores, California). An excerpt of relevant data in HL7 format is automatically transferred to the database of the patient data management system (PDMS) used at our intensive care unit (ICU).

2.3. Requirements for optimisation

Due to mostly practical reasons and deficits in the existing infrastructure, the AIMS is rarely used for direct recording of the preoperative assessment. In our clinic, the preoperative rounds usually take place at the patient’s bedside in the ward. To use real time data entry, PCs either would have to be installed in each patient room in the ward, or a considerable number of portable computers would have to be made available. In our hospital, more than 100 patients have to be visited by several parallel working anesthesiologists each workday. However, providing sufficient computer hardware in such a scale is not possible, firstly due to the considerable financial investment involved, secondly for technical reasons, such as limited battery capacity, heavy weight and the lack of networking between patients’ rooms. These problems surely may be solved, e.g. by mounting the computers on carts, installation of hospital-wide wireless LAN, etc., but only at unacceptable cost and effort. Clinical pilot projects revealed that the user acceptance of laptop data recording during the preoperative
visit is very low, but involves much administrative effort.

The data recorded routinely on paper during preoperative rounds are subsequently entered into the AIMS by the anaesthesiologist during the procedure in the operating room. Until now, the above-mentioned direct data entry has been realised in only a few areas, for example in the surgical ICU, where PCs are located in close proximity to the patient. In the past years, this organization proved to be principally manageable, with some inherently serious drawbacks:

- It has been shown that up to 50% of the information entered on manual records is inaccurate ([23]).
- Even after being reviewed by assistants, Osswald [24] found a 12% rate of incomplete records. Although these results cannot be directly transferred to the preoperative record, it still remains doubtful whether a higher quality of charts can be expected.
- The phrase "you can write what you like" is very true for anaesthesia records and a review of these sheets is simply too time-consuming. As a result few charts are reviewed.
- Data are lost or changed during data transfer from one medium to another.
- There is redundancy in recording the same data twice, first on paper and then electronically in a computer program. This needs additional time and manpower.

To make matters worse the format of the paper anaesthetic record and fields in the AIMS are not identical, leaving even more room for additional errors during manual data transfer.

2.4. Design objectives

The department's existing data management infrastructure requires an electronic solution for the integration of data gathered during the preoperative assessment. To attain this objective, we chose a solution based on handheld computers.

A catalogue of requirements was defined to fully incorporate the new module into the AIMS. The new software had to:

- be able to communicate to the greatest extent with existing programs, in particular with the desktop AIMS and the HIS,
- be able to transfer patient’s demographics, laboratory results and Admission, Discharge, Transfer (ADT)-data from the HIS
- guarantee a direct assignment of the data set via an internal patient ID, supplying the rounding anaesthesiologist with necessary basic information about the patient,
- preserve the consistency of existing database files. This was of the highest priority, because new data formats and database structures in the preoperative module would have risked incompatibility with the existing structure and thus was totally unacceptable,
- preserve the existing user interfaces that users had become familiar with as accurately as possible, hence minimizing the need for extra training sessions,
- be able to print out clearly organised instructions concerning the patient for the ward staff.

Beside these key requirements, data alignment with the HIS and printout should be possible at every workstation computer at the wards in order to keep the distances short for anaesthesiologists. The desired hardware would be a robust, light-weight device, easy to use and equipped with long-lasting batteries for unimpeded data entry.

3. User expectations and attitude

Parallel to the development of the system, we surveyed the future users — our department's physicians — using a questionnaire divided in two parts. The first part tested the fundamental attitude of the users towards new technologies in medicine. For this purpose, we used the UNIT-M questionnaire (Appendix 1) by Quinzio and Quinzio which is currently being evaluated for its psychometric characteristics [23]. In the second part of the questionnaire, we simply asked the users about the special expectations concerning the use of a handheld-based documentation system to learn more about attitude and possible objections. With the results of this survey, we tried to match the user's wishes and needs as far as possible even before implementing the system into routine use.

Fifty-four of the 81 physicians in our department (66%) returned the questionnaire, thereof 41 men and 13 women. 31.5% of them had already taken part in a general computer-related training. 14.8% were using handheld computers during work (usually as electronic reference book), 22.2% in private life. For the design of the new PDA software, the following results of the pre-implementation survey were in particular interesting and helpful:

- only 21 of the 54 physicians (39.8%) are satisfied with the current paper-based documentation of the preoperative round and the subsequent manual data entry during the operation,
• on the other hand, 40 (74.9%) do not believe that the Palm-based documentation will save time, overall, 68% (36 of 54) support the implementation of the new system.

In general, we found a strong correlation between computer experience and the acceptance of the new documentation media. Most interesting was the analysis of the free-text suggestions of the interviewees, showing certain objections concerning the planned system. Some colleagues expected problems in the doctor—patient-relationship when using PDAs during the visit. Several users requested a very extensive training before using the system in the daily routine, and some feared liability problems in case the PDA was stolen, lost or broken. These misgivings had to be respected during the implementation period.

4. System description

We chose a PalmOS-based PDA (Palm Inc., Milpitas, CA, USA) because these handheld devices are wide-spread, easy to use, versatile and relatively inexpensive. The PalmOS platform also provides powerful tools for program development. A C program, embedding the AIMS data entry fields of the preoperative module was developed using the GNU-C (GCC; http://gpc-tools.sourceforge.net) development environment for PalmOS. Data is entered with a stylus into data fields similar to the handling of the desktop software version (Figs. 1 and 2). Most fields concerning the preoperative round from the desktop application have been transposed to the PDA (Table 1). For better usability on the small screen, some have been split in sub-windows.

Despite the Palm’s smaller screen size, all data field content and logical algorithms are identical.

Data alignment with the HIS is realised using a standard docking station via a serial interface. On the desktop PC, a special program connects the handheld application with other clinical applications running locally on the PC (anaesthesia records, electronic patient file at ICU) and subsystems of the HIS (enabling access to laboratory, microbiology, patient administration). This “HISData” program is embedded in a Java environment (Sun Microsystems Inc., Santa Clara, CA, USA). Because program speed is not of primary importance, we chose Java software with its stable very simple and flexible structure. The different performance of the Java software and the previous C programmed software does not affect the user in this case.

The program’s user interface provides a ward list from which the doctor selects the patient directly or via a search function. Full access to all of the mentioned subsystems, however, is possible from the desktop PC only; for the handheld computer, a configurable but limited data set is pre-processed by the HISData interconnection software. Currently, all base patient data that fit into the anesthesia documentation software are being transferred to the PDA.

While the handheld sits in the docking station, the respective data from the selected patient are transferred to the Palm handheld into the NarkoPalm program after pressing the hot sync key. Parallel to the transfer of patient data sets, each synchronization currently contains an actualisation of the Palm program, and a preferences file containing variable data like staff information, ward names, etc. The contents of the preconfigured

### Table 1: Preoperative data fields in the desktop and Palm applications

<table>
<thead>
<tr>
<th>Data field</th>
<th>NarkoData (desktop)</th>
<th>NarkoPalm (PDA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient basic data</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Preoperative condition</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Medical examination results</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Patient classification</td>
<td>+</td>
<td>+ (Divided in two windows)</td>
</tr>
<tr>
<td>(ASA score, past medical history)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical examination</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Laboratory results</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Preoperative medication, orders to ward staff</td>
<td>+</td>
<td>+ (Divided in three windows)</td>
</tr>
<tr>
<td>Diagnosis (ICD-10)</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Planned procedure</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>(OPS-301)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2 Despite the Palm’s smaller screen size, all data field content and logical algorithms are identical.
selection lists, allowing a logic check as well as a simple calculation of risk scores are also stored in this preferences file. Risk scores follow the guidelines of the DGAI. The selection list content is identical to the desktop version (Figs. 2 and 3), because NarkoData for Windows and NarkoPalm use the same templates retrievable from the central server. The file also contains user identifications and passwords. It is small (currently 115 kb), variable and can be transferred quickly without constraining the users workflow.

During the assessment at the patient’s bedside, the anaesthesiologist completes the available fields of the Palm application (Table 1) following the same algorithm as the PC version. This also includes an identical integrated integrity check. Values that may not be represented within the selection lists may be entered manually using either a “virtual keyboard” on the PDA screen or “Graffiti”, a special Palm-specific font recognized by the handheld’s operating system. After completing the assessment, the preoperative file is retransmitted quickly without constraining the users workflow.

At the moment NarkoPalm is still running as a trial in the clinical routine of rather small departments (urology, orthopedics). Initial instability of the system (data loss during non buffered synchronization) could be fixed with an improved algorithm during data alignment. Now data on the handheld are deleted only after having been successfully saved on the server.

A function for data integrity and logical checks/error lists similar to the established integrity checks of the desktop version supports the user during data entry. The structure of the database was kept consistent by retaining the data format and by enabling integration into the desktop AIMS application. The HISdata interconnection software converts the NarkoPalm file into the known desktop format and controls the opening of the converted file with the NarkoData application, so no direct database access is performed from the handheld. After closure of all plausibility checks, the record is finally imported into the database by the desktop application. Using this indirect way, no new developing of database import tools had been necessary.

Operating speed of the program is sufficient to allow continuous work. However, there is still room for optimisation. The slow base line speed of the mainly used Palm model (m105, 33 MHz Motorola “Dragonball” Processor, 8 MB RAM) is noticed when the program is started. Starting the software currently takes about 7 s, while scrolling from a data field to another or to the main menu takes nearly
Integration of a handheld based anaesthesia rounding system 559

1 s. This is still fast enough for normal work, but noticed negatively by the users that are accustomed to the desktop PC’s working speed. As new, faster generations of PalmOS devices with faster processors by different manufacturers are available, working with the devices will certainly become more comfortable. Using a Palm Tungsten T2 handheld, for example, the scrolling is hardly noticeable.

The duration of data entry for each patient varies depending on the user’s experience with the device and the medical status of the patient. Using defined (virtual) patient charts, trained users needed 5:20–20:00 min of time to complete the anaesthesiological documentation. At the moment, a scientific evaluation of the duration of data entry and data accuracy compared with paper-based documentation is being performed in our department. However, independent from the used method the time needed for documentation is (and should be!) in most cases rather short in relation to the conversation with the patient and the physical examination.

After the end of the first trial phase, during which the software was improved continuously, software stability turned out very satisfactory. We are currently preparing the wide spread use of handhelds in clinical routine. At the present, 10 Palm m105 devices and two newer models are available in the department of anaesthesiology. This number is not sufficient to record all preoperative assessments within the hospital, but in the two mentioned surgical departments where the system is used all physicians on duty (usually six–seven) can use a device personally. Although, most colleagues support the introduction of the new system, there are still several fears concerning time consumption, necessary training and possible liability problems. We have tried to enhance the user acceptance by optimization of the software ergonomics, extensive training of the colleagues using the new device and information about the department covering eventually stolen or lost handhelds. All participating colleagues get an extensive training on general use of the handheld and handling of the NarkoPalm software. If the system proves itself reliable and useful, gradually more departments will be equipped with handhelds.

6. Discussion

Before PDAs can be introduced into clinical use, the principal choice between two different types of systems has to be made: PalmOS or PocketWindows (previously Windows CE). At the moment, PocketWindows handhelds have a better performance especially for the display of multimedia files (graphics, audio, video). On the other hand, these computers are still a lot heavier and more expensive than PalmOS based devices. In our clinic, we chose PalmOS devices because they contain all currently required system features. In the future, PDAs with bigger screens and higher resolution will be preferable. Similar models are already available from some manufacturers (e.g. Sony “Clie” series, Palm “Tungsten” series).

There is already a broad variety of medical programs available for PalmOS. Until recently, handhelds have been primarily used as decentralised reference databases, to keep personal schedules and data or to perform common calculations. The first reports of the use of handhelds integrated within a clinical infrastructure have been published recently, but most of these solutions are still trials within a limited application [26,27]. Only few network integrated solutions in anaesthesiology, like the one presented in this paper, have been described recently, demonstrating the general usability of handhelds in this particular environment [15,16,28]. If the handheld device is to bring real benefit to users and departments over and above the use as an electronic notebook [12–14,29], a bi-directional communication between the computer and the existing data processing infrastructure has to be implemented. In this way, a PDA can truly become part of a system. Rodríguez et al. even demonstrated a location-based integration of handhelds into a hospital network, which may be an interesting concept for future uses [19].

The preoperative anaesthetic assessment is a clearly structured standardised task making this part of anaesthesiological work well suitable for conversion to an electronic data storage medium. Several years of routine use of the AIMS in our clinic have proven that a user friendly, standardised and completely computerised recording of the anaesthesiological work process is possible in daily routine. This is supplemented by data of the preoperative assessment transferred from paper records. Changing from redundant data entry in the operating room to direct electronic recording at the patient’s bedside seemed simply logical. Required program adaptations were executed very quickly. In a current study, user and patient acceptance of handhelds in routine use is being evaluated; after this extended trial phase we will finally be able to judge the benefits and disadvantages of handheld devices for general use.

All mobile devices, whether notebooks or handhelds, are endangered of getting stolen or being
lost—the smaller the size, the higher is usually this risk. Furthermore, risk of damage is naturally higher than for fixed devices, like desktop PCs. In our opinion, these risks can never be totally avoided and have to be accepted, if mobile documentation should be used at all. By personal assignment of the devices, locking them overnight and careful handling, the risks can be minimized to an acceptable degree.

If a PDA may be lost or stolen, privacy of patient data will usually not be affected, because all patient data are automatically deleted on the PDA after synchronization with the desktop PC. Furthermore, access to the NarkoPalm application is password-protected (only users registered in the configuration file may start the application).

A common feature of all currently available handhelds is that basically every model needs a different docking station for connection to the desktop PC. This makes planning the equipment of a clinic with different brands (for extension or replacement) rather difficult, because each area requires the use of compatible docking stations and handhelds. At the moment, the possibility of wireless data transmission between PC and handheld via infrared or Bluetooth data ports instead of using the docking station is being studied.

An increasing number of PDAs based on a variety of operating systems uses wireless network ports (Wireless LAN, WLAN). Considering these developments, one can envision the use of PDA systems without any desktop PC connection. In our opinion, the necessary provisions for a wireless infrastructure and existing security problems in many WLAN surroundings make the use of wireless data transfer rather unattractive at the moment. Handhelds will be best established in clinical routine in the near future using the existing (wired) infrastructure. However, with the increasing availability of WLAN technique at more attractive costs, we will re-evaluate the usability of this technique in our clinical environment.

From our point of view, the state of current software development is satisfactory. Bi-directional communication between HIS and the Palm application runs almost trouble-free. Less satisfactory is that coding of diagnoses and procedures has to be entered at the desktop computer. For now, transferring these tasks to the handheld may make sense. Use of these catalogues on the Palm is being delayed due to the large memory and processor power requirements. The use of a stylus for data entry is also rather uncomfortable. Routine will reveal if coding and print out at the desktop computer are feasible or if another solution must be found.

**Summary points**

**What was known before this study**

- Anaesthesia information management systems (AIMS) fulfill the increasing requirements for medical, administrative and medico-legal purposes in anaesthesiology to a large extent.
- The electronic recording of the preoperative round at the patient’s bedside and seamless integration of the collected data into a hospital-wide network is desirable for consistent and reliable data processing.
- Handheld computers are small, light-weight devices dedicated for mobile data recording. However, the integration into hospital information systems has hardly been demonstrated yet.

**What this study has contributed to our body of knowledge**

- Mobile documentation of the preoperative round using PalmOS-based handhelds could be realised using similar data fields and workflow as in the desktop AIMS software.
- Information gathered using the handheld system could be integrated into the existing central database system by using a local desktop interconnection software and the established AIMS client to convert the data.
- A user friendly, standardised and completely computerised recording of the anaesthesiological work process is possible in daily routine.

The key element of the present application is the aspect of database consistency guaranteeing the integration of existing statistical tools. A consistent data format is of high importance for the long term use of data in an AIMS. In summary, we can say that within a very short period a meaningful integration of a PDA application into an existing AIMS could be established. Further similarly structured projects (e.g. recording of the postoperative assessment, rounds in the pain therapy or consultations) are in planning and will be executed upon successful final development of the preoperative module.

**Appendix A. The UNIT-M questionnaire**

(Use of new information technologies in medicine, Quinzio & Quinzio)
Integration of a handheld based anaesthesia rounding system

Please read the different statements concerning the use of computers in medicine listed below and mark whether you agree rather to the statement on the right side or to the statement on the left side.

**Examples:**

<table>
<thead>
<tr>
<th>Statement</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of EDP is hospital does not facilitate my work.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In this case you would state that EDP use in hospital rather facilitates your work.</td>
<td></td>
<td></td>
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<tr>
<td>The use of EDP in hospital does not facilitate my work.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>In this case you would state that EDP use in hospital does not at all facilitate your work.</td>
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</tr>
</tbody>
</table>

1. I enjoy to keep up to date on new technologies.                      | 3 | 2 | 1 | 0 | 1 | 2 | 3 |
2. An efficient EDP system is important for the reputation of the hospital. |   |   |   |   |   |   |   |
3. The use of EDP increases stress in clinical reality.                  |   |   |   |   |   |   |   |
4. Computers in medicine contribute to job satisfaction.                 |   |   |   |   |   |   |   |
5. Above all it's the administration who profit from the use of new technologies. |   |   |   |   |   |   |   |
6. Sometimes I worry that I can't catch up with new technologies.        |   |   |   |   |   |   |   |
7. EDP fits well into my work routine.                                   |   |   |   |   |   |   |   |
8. EDP makes the training of new employees more difficult.               |   |   |   |   |   |   |   |
9. I believe that the increased use of computers at work has no negative effects on my health. |   |   |   |   |   |   |   |
10. I think that the use of computers makes work much easier.             |   |   |   |   |   |   |   |
11. The increased use of computers is good for the patients.             |   |   |   |   |   |   |   |
12. My personal decision latitude is sometimes restricted by the use of EDP. |   |   |   |   |   |   |   |
13. I often do not know what the computer actually doing.                |   |   |   |   |   |   |   |
14. I have too many things at the same time because of EDP implementation. |   |   |   |   |   |   |   |

I do not enjoy to keep up to date on new technologies.
An efficient EDP system is not important for the reputation of the hospital.
The use of EDP does not increase stress in clinical routine.
Computers in medicine contribute to the creation of new jobs.
Above all it's the patient who profit from the use of new technologies.
I never worry that I can't catch up with new technologies.
EDP does not fit well into my work routine.
EDP facilitates the training of new employees.
I believe that the increased use of computers at work has no negative effects on my health.
I do not think that the use of computers makes work much easier.
The increased use of computers is bad for the patients.
My personal decision latitude is sometimes restricted by the use of EDP.
Most of the time I know what the computer actually doing.
I have less things to do at the same time because of EDP implementation.
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Integration of a handheld based anaesthesia rounding system


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