

A Compendium of Information Processing Functions in Nursing *Development and Pilot Study*

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Before introducing computers or other tools to support nursing care, it is important to have a clear picture of the information processing functions required in this area. This article presents a compendium of information processing functions used in nursing. This compendium can be used to support management of information systems in planning and monitoring nursing information systems. The article describes the development of the first version of this compendium and its evaluation in a pilot study. The results of this evaluation show that the compendium can be used to assess the quality of information processing in nursing.

Key words: Information processing functions in nursing, Management of information systems, Nursing informatics, Nursing information systems, Pilot study, Quality of information processing

INTRODUCTION

Computers in Nursing

For some years now, computers have been introduced in such diverse fields as nursing documentation, nursing staff scheduling, and order communication with other departments. Whereas the use of computers in non-patient-related nursing fields (e.g., administrative tasks such as patient admission or nursing staff scheduling) is common today, the use of computers in patient-related nursing fields (i.e., nursing documentation) is rather new, especially outside of the U.S.^{1,2}

Nursing information systems support various nursing tasks. In this article, the "nursing information system," as part of a hospital information system, encompasses not only computer-based information processing but also conventional information processing (e.g., paper-based information) in nursing.³ Thus, we will not only look at computer-based tools for information processing in nursing (often referred to as the nursing part of an electronic patient record)⁴ but also at information processing in nursing as a whole.

Nursing information systems, just as other parts of hospital information systems, are planned, monitored, and controlled by the management of information systems.⁵ By introducing computer-based nursing information systems, the management of information systems hopes to save time and money,

allow quicker access to relevant information, improve nursing documentation, and, finally, increase the quality of nursing care.^{6,7} However, computers may also have negative consequences; they are costly, can disturb the usual workflow, consume vast amounts of administration and teaching time, can be misused to control individual performance, and can create new problems, such as data loss or abuse.⁸⁻¹⁰ Therefore, it is essential that their introduction is planned thoroughly and that the desired goals and tasks to be supported are clearly established. We thus deem it useful to design a compendium of nursing information processing functions that nursing information systems should support.

Information Processing Functions in Nursing

We can use Gassert's five-phase "Model for Defining Nursing Information Systems Requirements" (MD-NISR)¹¹⁻¹³ as a framework for describing information processing functions in nursing. In the first phase, nurses' information processing functions, such as "admission," are established. In the second phase, general requirements are derived with regard to these functions, such as "presentation of admission data." In phases three to five, requirements concerning computer-based tools are determined, such as requirements concerning screen output or data structures.

The main advantage of using Gassert's model is that it distinguishes between information processing functions (phase 1) and information systems require-

ments (phases 2–5). The functions describe the daily information processing functions in nursing, independent of the tools used. The requirements are established with regard to special tools that will be developed, or purchased, and which should support these functions. Thus, the following question should be answered first: “What are information processing functions in nursing care?” Only then can the general requirements be derived and the final, detailed requirements regarding conventional or computer-based tools be determined.

Various research papers present results that match phases 2 (general requirement for nursing information systems)^{4,14} and 3–5 (concrete requirements for computer-based tools).^{15–18} However, papers focusing on information processing functions in nursing independent of tools are rare. Nevertheless, some ideas can be found in Gassert, Hannah et al., and Lagemann.^{12,18,19}

Aim of This Article

In this article, we will develop and test a first version of a compendium for information processing functions in nursing. This compendium could then be used to support *planning* of nursing information systems by deriving both general and detailed system requirements, according to Gassert’s model and *monitoring* of nursing information systems by offering a schema for the evaluation of information processing in nursing, based on different evaluation criteria. By this, the functional compendium can effectively support the management of a nursing information system.

DEVELOPMENT OF THE FUNCTIONAL COMPENDIUM

We developed a first version of the compendium for information processing functions in nursing in a three-phase procedure. In the first phase, we established typical nursing functions by analyzing the nursing process, searching through available literature and questioning nursing experts. We arranged the functions according to their degree of relation to the patient in three main categories^{2(p79)}:

- directly patient-related: management of the patient record
- partly patient-related: patient-related ward organization; patient-related communication with other departments
- non-patient-related: non-patient-related ward organization; communication within the ward and with other departments; access to information and knowledge; use of personal information processing tool.

In the second phase, we sent a draft version to 19 experts (5 nursing managers, 8 staff nurses, 5

nursing informaticians, and 1 physician) from five different German hospitals, asking them to comment upon the structure and content. These experts were selected because they had participated in a multicentered evaluation study on the effects of nursing information systems.^{2,20} Therefore, they were motivated and also competent enough to be seen as experts in the field of information processing in nursing. Comments came from all involved institutions. The comments were discussed via e-mail, and most of them were integrated into the compendium.

In the third phase, the revised functional compendium was resent to all participants with the final question on completeness. All participants agreed that the compendium seemed to be complete and adequately structured.

The resulting first version of the functional compendium (Table 1) comprises approximately 80 information processing functions in nursing care. These functions should be supported by nursing information systems. They are presented in a hierarchy of three levels. The names of the functions were chosen to be independent of the tools that may support them (paper based, computer based, or others). Thus, this compendium describes information processing functions in nursing as a whole, regardless of the tools used.

PILOT STUDY: EVALUATION OF THE FUNCTIONAL COMPENDIUM

To evaluate completeness of the developed first version of the compendium and its usefulness for the management of nursing information systems, we conducted a pilot study. First, we selected an application field for the compendium. As mentioned above, such compendiums can support the planning and monitoring of nursing information systems. Because we did not want to develop such a system, we decided to use the compendium to monitor information processing in nursing in this evaluation study.

Different evaluation criteria can be used for information processing in nursing, such as costs, benefits, and quality.^{21,22} We decided to use quality and importance as evaluation criteria.

We prepared the functional compendium by adding two columns: one column for the *quality* of the given information processing function, using a Likert scale from 1 (lowest) to 5 (highest), and one column for the *importance* of the given information processing function, using a Likert scale from 1 (lowest) to 5 (highest).

The *quality* of each function indicates the present state of its realization: Is the function well supported by the present information processing infrastructure, or are there problems, for example, concerning performance or costs of these functions?

The *importance* of each task represents its significance, seen from the point of view of the compendium user.

It seems important to stress that we did not aim at evaluating the importance and quality only of *computer-based* information processing, but rather the importance and quality of information processing functions in nursing (compare phase 1 of Gassert's model). It is obvious that the kind of tools (computer-based tools or not) actually used to support information processing does not directly determine the quality of information processing. It always depends on aspects such as organization of workflow, user's education, and quality of the tool itself. For example, even a simple paper-based form for nursing care planning can be judged as being of high quality if care planning is done quickly and efficiently and if the users are completely satisfied with it. By choosing this point of view, the compendium can be used for all kinds of hospitals, independent of the information processing tools used in nursing.

Study Design

The aim of the study was to evaluate the quality of information processing in nursing in five German hospitals by using the compendium for information processing functions in nursing. The study questions were:

1. How high is the quality of information processing in nursing?
2. How high is the importance of different information processing functions in nursing?
3. Which information processing functions cause the most problems?

The five participating German hospitals (the Dermatology University Hospitals and the Psychiatric University Hospitals in Heidelberg, the German Heart Center in Munich, the Clinic for Psychiatry and Neurology in Arnsdorf, and the Central Hospitals of Augsburg) were chosen because they had project groups that participated in the multicentered research project on nursing information systems.²⁰

We contacted these five project groups and asked them to participate. Nursing management and other staff members (mostly nurses and informaticians) made up the project groups. We felt that these multiprofessional project groups had a good overview of information processing in nursing in their hospital. Each project group submitted one form. Thus, we had five forms for our pilot study.

The study took place in May 1998. The project groups received the functional compendium and were asked to rank the quality of each nursing information processing function on a Likert scale from 1

to 5 and the importance of each nursing information processing function on a Likert scale from 1 to 5.

Within two weeks, the written answers were collected and assessed. To answer study questions Q1 and Q2, we used descriptive statistics. The mean of the responses of all hospitals was calculated for each nursing function, and then for each section and subsection of the compendium. According to the possible answers, these values can range from 1 to 5. To answer question Q3, we calculated the difference between importance and quality for the mean values of each subsection and section.

Results

We received a complete feedback form from each of the five hospitals. The aggregated results for all three study questions are given in Table 2. The three highest values in each row are marked. The figures indicated are the mean values of the answers of the five hospitals.

Table 3 presents the aggregated results for patient-related functions (section 1 of the requirement compendium), partly patient-related functions (sections 2 and 3 of the requirement compendium), and non-patient-related functions (sections 4–8 of the requirement compendium).

Q1: Quality of the Information Processing Functions

Table 2 shows that the quality of the information processing functions "Medical documentation" (3.85), "Communication inside the ward" (3.5), and "Access to nursing-related information" (3.65) were rated highest, whereas the functions "Nursing decision support" (1.5), "Nursing data analysis" (1.5), and "Management of orders" (2.2) were rated lowest.

Table 3 shows that non-patient-related functions were seen as the highest quality functions (3.45), compared with the other functions.

Q2: Importance of Information Processing Functions

The functions "Nursing documentation" (4.76), "Non-patient-related order communication with other departments" (4.78), and "Nursing decision support" (5.0) were seen as most important, whereas the functions "Management of patient-centered documents" (3.0), "Patient information and education" (3.62), and "Use of other organizational tools for ward organization" (3.73) were seen as least important.

Table 3 shows that patient-related functions are considered to be most important (4.57).

Q3: Most Problematic Information Processing Functions

The differences between importance and quality in Table 2 indicate functions that most urgently require improvement. The most problems seen by the hospi-

TABLE 1**A Functional Compendium for Information Processing in Nursing****Management of the Patient Record****Management of patient data**

- Searching patient data (e.g., by using a patient identification number)
- Documentation of patient data (including family, patient risks)
- Documentation of patient-related notes, checklists and dates

Nursing documentation

- Documentation of patient data relevant for nursing
- Documentation of nursing phenomena
- Documentation of nursing diagnosis and nursing problems
- Use of coding references (e.g., ICNP—International Classification of Nursing)
- Documentation of patient's resources
- Documentation of nursing aims
- Planning nursing tasks
- Documentation of nursing tasks
- Recording nursing categories
- Generation of nursing reports (e.g., when transferring or dismissing a patient)
- Performing nursing evaluations (e.g., evaluating if the nursing aims have been reached)
- Use of nursing standards (e.g., registration, administration, search, adjustment)
- Search for special criteria in the nursing documentation

Medical documentation (the part relevant for nursing)

- Management of the medical chart
- Documentation of medical orders (e.g., medication, laboratory, examinations, operations)
- Documentation of medical findings (e.g., laboratory findings, operation report)
- Documentation of medical diagnosis
- Access to medical referral letters
- Documentation of special therapy plans (e.g., nutrition)
- Documentation of patient information concerning diagnostics and therapy

Nursing data analysis

- Generation of queries (lists, statistics) (e.g., concerning patient, staff, nursing tasks)

Patient-related ward organization**Patient management**

- Admission of a patient
- Dismissal, referral of a patient

Generation of organizational tools

- Generation of labels of patient data
- Generation of letters, attestations, etc.

Organization of beds

- Organization of the beds in a ward (e.g., survey, reservation, shifting)

Management of patient-centered documents

- Management of medical records (e.g., borrowing, searching, returning)
- Management of other documents

Use of other organizational tools

- Generation of statistics about the patients in a ward
- Assignment of nurses to patients or rooms
- Generation of working checklists

Patient-related order communication with other departments**Communication with diagnostic/therapeutic departments**

- Use of a hospital-wide compendium of services (laboratory, microbiology, X-rays, operations, etc.)
- Administration of appointments (including priorities)
- Requests for therapeutic or diagnostic services (e.g., radiology, laboratory)
- Collecting and reading examination results

(Continues)

TABLE 1 (Continued)

A Functional Compendium for Information Processing in Nursing

Communication with other departments

- Ordering of transport means
- Ordering of meals
- Ordering of maintenance staff

Management of orders

- Generation of calendars (examination dates, operation dates, etc.)
- Generation of lists with pending orders

Ward organization (non-patient-related)

- Staff scheduling
- Organization of staff training
- Documentation of working hours
- Organization of the ward stock (e.g., drugs, laundry)
- Management of other non-patient-related resources (e.g., rooms, finances)

Communication inside the ward (non-patient-related)

- Exchange of information and other documents

Order Communication with other departments (non-patient-related)

- Ordering of drugs
- Ordering of laundry
- Ordering of other materials

Access to information and knowledge

Access to general information

- Access to telephone lists, staff lists, timetables, etc.
- Access to "black boards" for general information exchange

Access to nursing-related information

- Access to bibliographies (e.g., Medline)
- Access to medical reference-books
- Access to drug lists
- Access to other nursing-related information (e.g., books, databases, journals)

Access to hospital-related information

- Access to addresses (e.g., doctors, hospitals)
- Access to other internal information (e.g., articles, services, materials)
- Access to nursing standards and other nursing references
- Access to information concerning education and training (e.g., dates, courses)
- Access to other internal references (e.g., guidelines, instructions)

Nursing decision support

- Use of decision-support systems (e.g., for nursing care planning)

Patient information and education

- Give information about ward organization
- Give information about therapies, diagnostics, etc.
- Give information about stored patient data

Use of personal information processing tools

- Documentation of notes
- Generation of documents
- Generation of graphics
- Generation of tables
- Generation of statistics
- Management of a calendar
- Management of personal dates
- Management of internal or hospitalwide dates
- Use of personal communication tools (e.g., mail, e-mail)

TABLE 2

Importance and Quality of Information Processing Functions in Five German Hospitals on a Scale of 1 (= minimum) to 5 (= maximum). The Mean Values of the Five Hospitals are Presented and the Difference Between Importance and Quality is Calculated. The Three Highest Values in Each Row Are in Bold Type

	Importance	Quality	Difference
Management of the Patient Record	4.57	2.84	1.73
Management of patient data	4.58	2.53	2.05
Nursing documentation	4.76	3.48	1.28
Medical documentation	4.54	3.85	0.69
Nursing data analysis	4.40	1.50	2.90
Patient-related ward organization	4.06	2.81	1.25
Patient management	4.67	3.27	1.40
Generation of organizational tools	4.30	2.40	1.90
Organization of the beds	4.6	3.2	1.40
Management of patient-centered documents	3.00	2.40	0.60
Use of other organizational tools	3.73	2.80	0.93
Patient-related order communication with other departments	4.22	2.66	1.56
Communication with diagnostic/therapeutic departments	4.60	2.93	1.67
Communication with other departments	4.07	2.87	1.20
Management of orders	4.00	2.20	1.80
Ward organization (non-patient-related)	3.81	2.99	0.82
Communication inside the ward (non-patient-related)	4.25	3.5	0.75
Order Communication with other departments (non-patient-related)	4.78	2.87	1.91
Access to Information and Knowledge	4.19	2.88	1.31
Access to general information	3.80	3.03	0.77
Access to nursing-related information	4.30	3.65	0.65
Access to hospital-related information	4.26	3.13	1.16
Nursing decision support	5.00	1.50	3.50
Patient information and education	3.62	3.09	0.53
Use of personal information processing tools	4.04	3.45	0.59

tals were in the "Management of patient data" (2.05), "Nursing data analysis" (2.90), and "Nursing decision support" (3.5) functions. The fewest problems were seen in the "Patient information and education" (0.53), "Use of personal information processing tools," and "Management of patient-centered documents" (0.60) functions.

Table 3 shows that most problems can be found in patient-related functions, where the gap between importance and quality is highest (1.73).

Discussion

The results show that patient-related information processing functions are considered most important but of lesser quality than non-patient-related functions. The problems in information processing seem to increase when moving "closer" to the patient. Most demand for support of information processing can therefore be found in the field of patient-related

functions. The reason may be that non-patient-related functions have already been well supported by computer-based tools for many years, whereas support of patient-related functions, such as nursing process documentation, is rather new.

These results confirm the decision of the hospitals to participate in the mentioned multicentered research project ("Support of the nursing process through the use of information and communication technologies"). The aim of this project was to find methods and tools to support better the nursing process that is a directly patient-related function.

Since our pilot study was conducted as a first evaluation of the function compendium, we used a rather limited and not randomized sample of five hospitals. Each of the hospitals returned one form. Nevertheless, our results show many parallels to results presented in other literature. Ninety nursing experts in the United Kingdom were questioned in a Delphi study about the future use of computers in

TABLE 3

Aggregated Results on Importance and Quality of Information Processing Functions in Five German Hospitals on a Scale of 1 (= minimum) to 5 (= maximum). The Numbers Represent the Mean Values of the Corresponding Subsections of the Functional Compendium

	Importance	Quality	Difference
Patient-related functions	4.57	2.84	1.73
Partly patient-related functions	4.14	2.74	1.40
Non-patient-related functions	4.04	3.45	0.59

nursing.²³ The results show demands for further support mainly in care planning, order communication, and improved patient administration.

Because only the project groups of the five hospitals were questioned, the results represent only their group evaluations. We do not know how the evaluations were determined within the groups and who finally filled out the forms; therefore, we do not know if the answers represent the opinion of the nursing management, of the nurses, or of the informaticians involved in the groups. It would be interesting to use the functional compendium to assess opinions of representatives from each of the professional groups and to compare them.

This assessment of information processing can only be a subjective one, seen from the point of view of those people who use the compendium. However, as evaluation research shows,²⁴⁻²⁶ the opinions of the people are a central component in each evaluation of information systems. Further, compared with "objective" evaluation studies, the functional compendium, in its present form, can be used very easily and in a cost-effective way.

Overall, our pilot study showed that the functional compendium is useful to support the management of information systems in the task of monitoring information systems. By using the compendium, we received an overview of the quality of information processing in nursing in five German hospitals. Problematic functions that should be supported better could be found by comparing the importance of the functions with their present quality.

We did not test the compendium for the task of planning nursing information systems. Here, the compendium could be used to derive requirements for nursing information systems, as proposed in phase 2 of Gassert's model. In this case, a similar pilot study should be conducted.

CONCLUSION

The functional compendium is an easy-to-use and powerful tool that can support the management of

nursing information systems in its planning and monitoring tasks.

Using the compendium as we did in the pilot study, hospitals can get an overview of the quality of information processing functions in nursing. By comparing quality and importance, indications of shortcomings in information processing in nursing can be found. The quality can thus be measured and then compared with other wards, departments, or hospitals. This is an important precondition for the monitoring of nursing information systems.

Evaluation criteria other than quality and importance, such as costs or benefits, could be used. The compendium can also be used to plan investments in information processing. However, the compendium can only give hints about *where* changes and investments are necessary, not *which* changes should be made. Reaction to problems could, for example, be the analysis of organizational problems, change of workflow, reengineering conventional tools, such as forms, or the introduction of computer-based systems.

The usefulness of the compendium for the planning of information systems was not considered in our pilot study, this is to be shown in further studies.

Further, broader studies are also necessary to verify the final completeness of the functional compendium. It may be useful to better take into account the process-oriented nature of nursing tasks (rather than the purely functional view). Here, the integration of scenarios or use cases that show the process of nursing functions seems to make sense and should be examined further.

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