EVALUATION OF HOSPITAL INFORMATION SYSTEMS

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ABSTRACT

Introduction: Nowadays the adoption of hospital information systems plays critical role in advanced health care delivery, reduction of medical error and promoted patient care. Evaluation of hospital information systems is mandatory for its successful adoption. In the hospital environment the evaluation of hospital information systems is difficult due to the several factors that are involved. One of these factors, of special importance, is user satisfaction.

Purpose: To evaluate the level of satisfaction of users in the Kavala’s hospital in Greece, where the information technology infrastructure is in early stages.

Materials and Methods: For the purpose of this study the System Usability Scale questionnaire was used, which has not ever used before for evaluation in hospital environment. The participants of the study were worked in the Kavala’s Hospital, which is placed in the homonymous Greek city. Users were divided in two groups: the administrative group containing the administrative employees-participants of the specific hospital and the health care group containing the health-related professionals occupied in the same hospital.

Data Analysis: Users scored the existing information system as fairly usable. Users’ opinions related to system’s frequency of use, easy to use and learn, inconsistency, integrity, technician’s support are discussed. The results of this pilot study showed significant correlations between several factors in each of the groups, which are discussed. Special importance has the interrelations among Confidence- Integrity- Frequency of use and Integrity-Complexity-Inconsistency, observed in both groups.

Conclusion: The SUS proved an effective questionnaire for the evaluation of user satisfaction in hospitals. The newly designed “CIF” (Confidence-Integrity- Frequency of use) and “ICI” (Integrity-Complexity-Inconsistency) triangles are are described with good assessment of results.
ACKNOWLEDGEMENTS

I wish to thank the patients and staff who helped with this study. I would like also to express my gratitude to my fiancé, parents and parents in law for their support.

“Except for the help listed in the Acknowledgements, the contents of this thesis are entirely my own work. This work has not previously been submitted, in part or in full, for a degree or diploma of this or another University or examination board”.

Chiotaki Nikomacheia

September 2005
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1.1. INTRODUCTION

Hospital Information Systems (HISs) contribute to an efficient patient care with high quality (Heeks, 2005a) and comprise data transfer with the associated hospital employees, at the right place and time, promoting interoperability among them (Winter et al., 2003). In other words, HIS is principally focused on the patient, as well as on medical and nursing care, and the administrative and management issues needed to support these kinds of care (Heeks, 2005a).

The HIS offers indisputably significant opportunity for the development of the efficacy and the efficiency of the health care (Jaspers et al., 2004a) through their frequent application in Medical Informatics (Pietka, 2003). The implementation of HIS affects the structures, the processes and the outcomes in the health care environment (Despont-Gros, Mueller and Lovis, 2005).

The introduction of methods and tools in order to support homogeneity and accountability of healthcare decisions and actions is important (Kalogeropoulos, Carson and Collinson, 2003). However, the increasing adoption of information technology (IT) in patient care necessitates the establishment of reliable evaluation of information systems (Lee, 2004). Nevertheless, the first issue in any evaluation is, the key questions to cover all relevant perspectives (Wyatt and Wyatt, 2003).

Furthermore, for the successful installation and adoption of HIS, structured assembling of user’s needs and system requirements is essential (Staccini et al., 2005). Therefore, user’s opinion and satisfaction is fundamental for the successful adoption of HIS (Wu and Wang, 2005).

The purpose of the study is to evaluate the adoption of an innovative HIS in a Greek hospital, stated in Kavala city, as far as concerns user satisfaction. Currently, the existing HIS in the specific hospital is in early stages. This effort concentrated to users’ opinion for the existing information system, examining several aspects via the SUS questionnaire, which has not ever been used for the evaluation of user satisfaction in a hospital environment.
1.2. THE HOSPITAL INFORMATION SYSTEMS

1.2.1. General Description

A HIS is the socio-technical subsystem of a hospital (Brigl et al., 2005), using a database applied system based on the modularised structure of Browse/Server (Chang et al., 2003). Heeks (2005a) describe health information systems, as systems for processing data, information and knowledge in health care environments and HISs are just one category of health information systems, with a hospital as health care environment.

According to Brigl et al. (2005), these systems support information management by:

- Combining the hospital aims with the defined targets of its strategic information management,
- Promoting paper-based and computer-based information processing,
- Identifying gaps in services, which determine the tactical strategy to be accomplished.

The three aspects of an innovative Health Information System are the patient data management (through an Electronic Patient Record), the medical decision support (through a Guideline Management System) and the organisational support (through a Workflow Management System) (Ciccarese et al., 2005). However, its successful maturity and application demands working within an information partnership to maximise coordination, collaboration and cooperation (Maybloom and Champion, 2003).

1.2.2. The Structure of the Hospital Information System

The Health Information Systems are currently varied from distributed (based on messaging approach, Grid-like linking approach or are portals with Clearinghouse functions) to centralised options, which have one patient repository (Ruotsalainen, 2004). According to Pietka (2003), in order to make a clear structure of Hospital Information System, the function of hospital information module and its implementation to the several hospital departments have to be
taken into account. Therefore, the overall structure of a Hospital Information System is consisted of:

- **Patient-oriented modules**
  - Kernel modules, which comprise patient admission, discharge and transfer, registration of medical activities, registration of diagnoses and therapy, order entry, access to patient data.
  - Stand-alone modules designed for ancillary departments and applied to clinical departments with specific operational requirements, different from those of general hospital orientation, such as radiology and clinical laboratories.

- **Hospital-oriented modules**
  - Administrative modules
  - Finance and billing modules
  - Management information and decision-support module (Pietka, 2003).

Good interface design requires a deep understanding of work practices to adequately represent these practices in system design specifications (Jaspers et al., 2004b).

### 1.2.3. The Functional Requirements of a Hospital Information System

The processes that should be supported by a HIS are defined by Gell et al. (2000), in a systematic list, in which the structure has the following order: core processes, process fields, processes and sub-processes or functions. Based on information managers’ needs, Winter et al. (2003), have assumed the requirements on a meta model for HIS and its management, which are:

- Besides software and hardware components, conventional tools have to be modelled.
- Information has to be modelled as entity types used by enterprise functions.
- Entity types should be represented in form of datasets, forms and messages.
• Relationship modelling for enterprise functions, as well as for tools (software, hardware and conventional tools) should be considered and their interworking should be in accordance with these relationships.
• Communication sequences modelling are required for the successful interchange and communication of information among components.

1.2.4. Benefits of Hospital Information System Application

The benefits, pending from the application of a Hospital Information System are several, such as facilitation of the information sharing (knowledge management) (Kalogeropoulos, Carson and Collinson, 2003), compatibility, mass archives, security, high reliability, simple operation and support of medical information formats of images, figures and texts (Chang et al., 2003). The technology-enabled clinical management also contributes to cost controlling, quality of care acquisition and the rapid translation of biomedical research into patient care (Ball, 2003). On the other hand, Hospital Information Systems are recommended to support the scientific homogeneity and accountability of healthcare decisions and actions; to contribute to overall reduction in cost, improved quality of care and patient satisfaction (Kalogeropoulos et al., 2003). Finally, via Hospital Information Systems, and their applications, the taken clinical decisions are more appropriate and medical errors are avoided (Johnson et al., 2004).

1.2.5. The Clinical Information System

A clinical information system (CIS) includes order entry and reporting systems, electronic patient records, telemedicine and decision support tools for health professionals, patients and the public (Wyatt and Wyatt, 2003). The purpose of a CIS, as part of the hospital information system, is to provide direct access to clinical information, immediate and easy storing of new information and decision support (Feied et al., 2004). Clinical information database is essential due to integration among health-related specialties in order to achieve optimisation of care (Dziuban, 1999). Clinical systems should require two at maximum steps for
information access and should also be rapid especially in emergencies, where first seconds are critical; to avoid slower systems, which may lead to adverse events and as well (Feied et al., 2004).

The functional integration of CISs at institutional or regional level is based on primarily on the exchange of Health Level 7 and Digital Imaging and Communication in Medicine (DICOM) messages (Katehakis et al., 2001). According to Tsiknakis et al., the promising tendency concerns an autonomous CIS and a modular underlying health information infrastructure offering facilitating services to the distributed clinical data of a patient.

1.3. INFORMATION FLOW IN THE HOSPITAL

1.3.1. Information Sharing

The knowledge sharing and its exploitation are encouraged for the development of research and evidence-based medicine (Loef and Truyen, 2005). The information sharing through Electronic Patient Record support also clinical research, population health, health administration, financing and health service planning (Takeda et al., 2000). On the other hand, the collection, analysis and exchange of clinical, billing, and operational data within the organisational welfare influences functionality of health care services (Bose, 2003). Therefore, knowledge management systems should be considered too, as through the improved knowledge sharing and creation, receptive costumer services and advanced patient care could be obtained with reduction in costs (van Merode et al., 2004).

Knowledge management has incredible function and importance to the health care industry, mainly for hospitals and hospital systems, contributing to a more cost-effective and error-averse system delivery (Guptill, 2005).

1.3.2. Handheld devices

Handheld devices, such as “personal digital assistant”, “handheld”, “palm pilot” or “pocket pc”, have similar functions and are effectively applied in the healthcare
sector providing and continually improving the access to clinical information contributing to the healthcare promotion (Lu et al., 2005). Furthermore, handheld devices promote patient safety and care delivery through access to appropriate resources (Taylor, 2005).

1.3.3. Shared Decision Making

Shared decision making concerns the processes during which patients are informed about the potential harms and benefits or options for the treatment and screening decisions regarding patients preferences (Ruland, 2004a). For the right health care decision making the patients’ experiences, preferences and principles are regarded as vital (Ruland and Bakken, 2001). It is also worth mentioning that information sharing, as well as collection and storing, present the dilemma about the level of patients’ personal privacy protection and the level of information flow (Anderson, 2000).

1.3.4. Clinical Decision Support Systems

Computerised Clinical Decision Support Systems are software for decision-making support using the patient-oriented information in comparison with clinical knowledge database in order to conclude to recommendations or evaluations (Rothschild, 2004). These systems are associated with improved practitioner performance (Garg et al., 2005), medical error reduction (Kaushal et al., 2003) and evidence-based clinical guidelines application (Kuperman and Gibson, 2003).

1.3.5. Computerised Physician Order Entry

Computerised Physician Order Entry (CPOE) is the process that allows direct entry of medical orders by the health care decision maker (Kuperman and Gibson, 2003; Ash et al., 2005) and provides patient care by improving communication, information access and decision support (Rothschild, 2004). The CPOE process is demonstrated in Table 1. The effectiveness of these systems depends on the extent to which they are integrated with systems in clinical
laboratories, radiology and patient records (Ball, 2003). The implementation of CPOE is not easy but is worthwhile for the intended positive results; to avoid the negative unintended consequences that may be appeared, the clinicians should be trained to choose the computerised systems (Kuperman and Gibson, 2003; Ash et al., 2005). The requirements and costs are presented in Table 2.

![Diagram](image_url)

Table 1: CPOE permits Clinician to enter order directly to a computer workstation, which is linked to a hospital clinical information system (Rothschild, 2004) execution

- Hardware,
- Software,
- Technical support,
- Integration with existing systems,
- Extensive information infrastructure, sufficient number of workstations,
- Fast, secure and reliable computer network,
- Electronic interfaces between CPOE and other applications within the hospital (registration, laboratory pharmacy, radiology and nursing documentation),
- Help-desk for technical problem acute execution,
- Staff training.

Table 2: Requirements and costs for the successful implementation of CPOE (Kuperman and Gibson, 2003).

### 1.3.6. Electronic Health Record

Electronic Health Record (EHR) creates complete clinical documentation representing a rich source of data concerning medical and non-medical patient information (Blobel, 2004), leading to accurate decision-making and decreased medical errors (Johnson et al., 2004). The EHR structure should provide reliability between doctors and doctor to patient cooperation and communication based on the patient’s consent (Blobel, 2004).

### 1.3.7. Electronic Patient Record (EPR) Systems

Electronic Patient Record (EPR) Systems are powerful to support all the health-related information, legal aspects and the wide variety of hospital
information systems, contributing to professional’s time saving and total labour cost (Monteiro, 2003). The two approaches developed for EPR architectures, as Takeda et al. (2000) presented in their study, are demonstrated in Table 3.

<table>
<thead>
<tr>
<th>Document-oriented methodology</th>
<th>Object-oriented methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use of Internet</td>
<td>• Use of network technology</td>
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<tr>
<td>• Use of Mark-up languages for</td>
<td>• Characteristics from HL7</td>
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<tr>
<td>standarisation of</td>
<td>Reference Information</td>
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<tr>
<td>electronic</td>
<td>Model (RIM), CEN,</td>
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<tr>
<td>representation of paper-</td>
<td>Distributed Combonent</td>
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<td>based health care</td>
<td>Object Model (DCOM),</td>
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<tr>
<td>documents and forms</td>
<td>CORBA and CORBAmed and</td>
</tr>
<tr>
<td>• Documents are written to</td>
<td>GEHR</td>
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<tr>
<td>conformation to a</td>
<td>• Object dictionary for</td>
</tr>
<tr>
<td>particular (DTD).</td>
<td>translation of definitions</td>
</tr>
<tr>
<td>• Use of XML DTDs.</td>
<td>of data that are going to</td>
</tr>
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<td></td>
<td>be transferred.</td>
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</table>

Table 3: Characteristics of the two major approaches for EPR data architecture (Takeda et al., 2000).

1.4. INFORMATION TECHNOLOGY IN HOSPITALS

1.4.1. Information Technology and Medical Error Reduction

Information technology can be applied in medication error limitation both at inpatients and outpatients cases (Kaushal and Bates, 2002). On the other hand, the cost-effectiveness of most proposed improvements in error reduction and patient safety remains unknown (Warburton, 2005). Although IT interventions are expensive and demand the training of the hospital staff, the savings and the advantages are probably greater in most of the cases (Kaushal and Bates, 2002; Edwards and Moczygemba, 2004). The several applications of IT in hospitals are presented in Table 4.

According to Simpson (2004), IT implementation is depended on:

- How well the system is managed from the users,
- The well designed process (structure, meeting organisation’s objective), and
- If the computer program is adopted harmonically from the organisation (technologically and socially).

Based on increased demands on healthcare services, the health information systems tend to be modified in order to offer a shared caring concept and dilated network, promoting cooperation and communication among direct and indirect
care providers -and also among different healthcare institutions-, combined with the minimum competitiveness (Blobel and Holena, 1998).

<table>
<thead>
<tr>
<th>INFORMATION TECHNOLOGY APPLICATION IS HOSPITALS</th>
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<tbody>
<tr>
<td>Computerised Physician Order Entry (CPOE)</td>
</tr>
<tr>
<td>• Improves the drug ordering process</td>
</tr>
<tr>
<td>• Order regulation</td>
</tr>
<tr>
<td>• Legible</td>
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<tr>
<td>• Complete</td>
</tr>
<tr>
<td>• Provide additional information to physician for the medication in accordance to the patient case.</td>
</tr>
<tr>
<td>• Can be combined with the Computerised Decision Support System (CDSS) or the Computerisation of the medication administration record effectively.</td>
</tr>
<tr>
<td>Computerised Decision Support System (CDSS)</td>
</tr>
<tr>
<td>• Basic mode provide information for drug selection, dosing and duration.</td>
</tr>
<tr>
<td>• Advanced mode offer additional patient-specific and pathogen-specific information and advices to physicians.</td>
</tr>
<tr>
<td>Computerisation of the medication administration record</td>
</tr>
<tr>
<td>• In combination with CPOE decrease the medication errors that happen in the transcribing stage.</td>
</tr>
<tr>
<td>Automated dispensing</td>
</tr>
<tr>
<td>• Robots can be used for the automation of drug ordering, transcribing and dispensing stages.</td>
</tr>
<tr>
<td>Automated drug distribution systems</td>
</tr>
<tr>
<td>• Contain computer-controlled devices.</td>
</tr>
<tr>
<td>• Use for packaging, dispensing and distributing medication.</td>
</tr>
<tr>
<td>Medication bar coding</td>
</tr>
<tr>
<td>• Drug name, drug dose and administration time identification.</td>
</tr>
<tr>
<td>• Staff and patient name identification.</td>
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<tr>
<td>“Smart” intravenous devices</td>
</tr>
<tr>
<td>• Used in cases of intravenous medication usage.</td>
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<tr>
<td>• Devices with simplified programming and computerized checks.</td>
</tr>
<tr>
<td>• Reduce the intravenous medication errors.</td>
</tr>
<tr>
<td>• Dose controlling.</td>
</tr>
<tr>
<td>Computerised discharge prescriptions and instructions</td>
</tr>
<tr>
<td>• Provide easy access to inpatient, outpatient and emergency room settings.</td>
</tr>
<tr>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>• Provide immediately all the up-to-date information for the patient.</td>
</tr>
<tr>
<td>• Reduce medication errors.</td>
</tr>
<tr>
<td>• Easy to use.</td>
</tr>
<tr>
<td>• Inexpensive.</td>
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</table>

Table 4: Several applications of facilitating the information flow IT in hospitals (Kaushal and Bates, 2002).
1.4.2. Integration of Hospital Information Systems

Since the HIS reflects the heterogeneity of a hospital, the need for integration for the concentrated internal communication among organisational units and health-related professionals is intensive (Winter et al., 2003). HISs must be integrated in accordance with the hospital’s organisational structure (Ball, 2003) and therefore due to RIS and PACS systems in order to be inoperable (Chang et al., 2003). Additionally, the central planning for the decision process and the control system for the assurance targets are essential as part of the integration (van Merode et al., 2004).

According to Monteiro (2003), the integration could take place due to three dimensions: geographical distribution, heterogeneity and autonomy. The integration of the healthcare information systems contributes to the diminishment of the medication errors and the adverse drug events via the systemic discharge of IT and the upgrading in error reporting (Anderson, 2004) and is necessary due to different applications of critical value in a large number of sections (Monteiro, 2003). Electronic Patient Record (EPR) Systems are seemed to be the future of the integrated health information systems (Monteiro, 2003).

Hospital Resource Planning, as application of Enterprise Resource Planning (ERP) systems in hospitals, enforce hospitals on a more flexible reaction to changes in the environment (van Merode et al., 2004). These systems are focused in business factors’ integration such as sales, orders, logistics, inventory, accounting and personnel (Monteiro, 2003), and also controlling costs through improved resource management (van Merode et al., 2004).

1.5. EVALUATION OF HOSPITAL INFORMATION SYSTEMS

1.5.1. Evaluation to Health Care Organisations

According to Ammenwerth et al. (2004) "evaluation is the act of measuring or exploring properties of a health information system (in planning, development, implementation, or operation), the result of which informs a decision to be made
concerning that system in a specific context”. System’s evaluation in biomedical informatics should be a constant, strategically planned process (Miller, 1996), assisting the information technology to keep its role; to transform the shape and the structure of health care practices (Berg, 1999).

According to Dixon (1999), design, implementation and evaluation are engaged at all stages in a triangle scheme, for the successful adoption of an information system, where each of the above variables function with the other two in accordance with the chicken and egg connection. In this triangle, evaluation is a composite and multidisciplinary process with complicated answers about the “how” and “what” to evaluate, especially in the health care environment where the complexity of evaluation is much more evident rather than in other organisational areas (Despont-Gros, Mueller and Lovis, 2005). As evaluation is critical to the development and successful integration of knowledge-based systems (Clarke et al., 1994), some investigators tried to solve the latter problem providing frameworks, models and tools for the evaluation of health information systems, and some others tried to modify them. However, this attempt proved ineffective due to insufficient agreements concerning the different claims among the investigators (Despont-Gros, Mueller and Lovis, 2005).

Moreover, systems should be assessed in accordance with the standards defined from the research of activities that suit in the hospital policy and to the public health, risk management and financial factors (Feied et al., 2004). Strategic information management is important for maintaining and improving health information systems preserving privacy and considering the need for new architectural of HIS due to the new global environment, the extended use of data including research and the new types of data (Heeks, 2005a). The evaluation of HIS will be more demanding in the future when recommendations will become regulations supported by national legal bodies (Ammenwerth et al., 2003a).

On the other hand, the adoption of the modern computerised technology in a hospital is very expensive and therefore should be examined carefully as any expenditure without a measurable return on investment (Butler and Bender, 1990). The ability to improve efficiency and outcomes while decreasing costs
through information systems are all potential benefits of a comprehensive clinical information system. That may be resulted by allowing for multiple and instant simultaneous access to information, through data monitoring and altering, through automation of protocols, and by collecting information for population-based health care as opposed to individual illness-care (Chin and McClure, 1995).

Information system’s success is considered either as a multifactor aspect depending on context, objectives and stakeholders, or as a one-dimensional aspect, presented as satisfaction’s surrogate (Despont-Gros, Mueller and Lovis, 2005). It is therefore worth mentioning that health care information system’s failure is an important theme not only for information management professionals, but also for the consumers of health services (Beynon-Davies and Lloyd-Williams, 1999).

### 1.5.2. Factors Affecting Evaluation

According to Li (1997), the information system success evaluation process depends on 46 factors (Table. 5) from each and every functional area and from both health professionals and information systems personnel.

The most important variables for hospital information systems’ evaluation are the information system’s success, the user acceptance and the user satisfaction (Despont-Gros, Mueller and Lovis, 2005). Acceptance and satisfaction are treated as equivalent from some researchers, where from other researchers acceptance is encountered as a combination of user satisfaction and information system’s usage (Despont-Gros, Mueller and Lovis, 2005). Satisfaction and acceptance are also considered as user attitudes, as they influence and lead the interaction between users and technology (Despont-Gros, Mueller and Lovis, 2005).

Organisational factors are important predictors for dispersal of information technology innovations as far as individual effect may vary on each innovation (Ash, 1997). In many cases the organisational issues have been demonstrated
as the most difficult pieces of system’s implementation and operation (Southon, Sauer, and Dampney, 1999).

<table>
<thead>
<tr>
<th>FACTORS AFFECTING THE EVALUATION PROCESS</th>
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<tbody>
<tr>
<td><strong>System Quality</strong></td>
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<tr>
<td>Response/turnaround time</td>
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<td>Convenience of access</td>
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<td>Features of computer language</td>
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<td>Realisation of user requirements</td>
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<td>Correction of errors</td>
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<td>Security of data and models</td>
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<td>Documentation of systems and procedures</td>
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<td>Flexibility of the system</td>
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<td>Integration of the system</td>
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<tr>
<td><strong>Information use</strong></td>
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<tr>
<td>Volume of output</td>
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<tr>
<td>Competition between CBIS and non-CBIS units</td>
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<td>Allocation priorities for CBIS resources</td>
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<td>Relationship between users and the CBIS staff</td>
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<td>Personal control over the CBIS</td>
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<td>Organisational position of the CBIS unit</td>
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<td>User’s attitude toward using CBIS (2)</td>
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<td>Communications between users and the CBIS staff</td>
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<tr>
<td><strong>Individual impact</strong></td>
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<td>User’s expectation of computer based support</td>
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<td>Job effects of computer-based support</td>
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<tr>
<td>Perceived utility</td>
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<tr>
<td><strong>Organizational impact</strong></td>
</tr>
<tr>
<td>Effectiveness of the systems (2)</td>
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<tr>
<td>Efficiency of the systems (2)</td>
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<tr>
<td>Productivity improved by the CBIS (2)</td>
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</table>

Table 5: Factors affecting Hospital Information Systems Evaluation (Li, 1997).
Perceived usefulness and perceived ease of use are key determinants of user acceptance and satisfaction. Perceived ease of use is “the degree to which a person believes that using a particular system would be free of effort”. Perceived usefulness is “the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). Both these terms affect indirectly the organisational mobility (Zain et al., 2005). The relation between perceived usefulness and perceived ease of use and system characteristics affecting the probability of system use, is examined by the Technology Acceptance Model (TAM) (Legris, Ingham and Collerette, 2003).

Recognising the pragmatic and skilled characteristics of health professionals’ work is a vital aspect in information systems’ evaluation (Berg, 1999). Without effectiveness’s measurement, information system’s assets may be undervalued or overvalued conflicting the functional strategic planning (Grover, Jeong and Segars, 1996).

During information systems’ evaluation the environment in which the information system will be implemented and the users who will use it in their information process role should be also considered (Ammenwerth et al, 2003a).

1.5.3. Evaluation Planning

Information system implementation is often validated through a cost-benefit analysis, although this analysis may include assumptions and factors confounding this procedure (Chin and McClure, 1995). According to Johnson (2005), information technology planning can be composed of three phases:

- The assessment phase: User needs, environmental factors, business objectives, and IT infrastructure needs are documented and assessed during this phase.
- The prioritisation phase: During this phase the procedures are prioritised in accordance to:
  - Costs
  - Benefits
  - Risks
Performance requirements (time and personnel requirements).

- The scheduling phase, during which considerations, personnel availability, and budgetary constraints are scheduled to produce an IT plan in accordance to organisational goals.

Wyatt and Spiegelhalter (1990) proposed the evaluation of medical expert systems to be done in two testing stages:

- The laboratory testing, in which potential users and developers’ perceptions are important.
- The field-testing during which the study must be designed to test without predispositions, in order to examine its influence in structure, process and outcome in the health care delivery.

Clarke et al. (1994), described a development evaluation cycle regarding the following stages:

(i) The early prototype development,
(ii) The validity of the system,
(iii) The functionality of the system, and
(iv) The impact of the system.

Beuscart-Zephir et al. (1997) supported in their study the necessity of:

- Evaluating the usability of the Information Technology (IT) and
- Understanding the purpose of the management of information, during the process of evaluation, in order to help the healthcare professionals in the integration of information management in their daily activity.

In the preliminary phase where Users’ Requirements are taken into account and developers of information systems must use quality management techniques to guarantee that the system will persuade given requirements (Beuscart-Zephir et al., 1997).

Measurements of information system’s assessment include techniques, medical and health efficacy, economics, sociology, and law and ethics (Grémy and Degoulet, 1993). According to Ammenwerth et al. (2003a), the main aspects that should be taken into account during the hospital information systems evaluation are the following:
• Particular attention to information’s technology selection and installation,
• Technical and system features, concerning the performance and the software quality of the selected information system,
• User acceptance,
• System usability,
• System effectiveness in structural and process quality in an enterprise with a lot of different kinds of users,
• System effectiveness in quality of care,
• Patient satisfaction with information technology,
• Investment and operational cost for the information technology adoption.

The challenge in an information system’s project is the evaluation designing that capture the complexity of interactions, interrelationships, and inter-effects occurring during a series of processes, which change the organization, the people, and the information system involved (Kaplan, 1997).

1.5.4. Evaluation Methods

1.5.4.1. Formative and Summative methods

The formative assessment measures and observes the information resources themselves in the several stages of development and concerns also the technical verification of an application (Talmon et al., 1999). Formative evaluation provides feedback for improvements before the final product is put forth (Currie, 2005).

On the other hand, the summative evaluation regards the measurement and the performance of the information resources and the behaviour of the people that use these resources (Talmon et al., 1999). Summative research examines the impact or the outcomes associated with the use of the system (Currie, 2005).

Therefore, formative and summative are applicable to computer system evaluation because informatics evaluation takes place both during and after system development (Currie, 2005).
1.5.4.2. The Objective or Quantitative Method and the Subjective or Qualitative Method

According to Barbour (1999), qualitative approaches may contribute to quantitative task and vice versa and their combination is important in health services’ research.

The objective or quantitative method is used to collect objective data such as patient waiting times, the number of lab tests ordered per patient or staff satisfaction on 1–5 scale using quantitative measurement standards, such as user satisfaction, usage indicators or time studies (Wyatt and Wyatt, 2003).

The subjective or qualitative research techniques provide answers concerning the reasons and the ways that quantitative studies cannot provide in HIS implementation and evaluation studies (Ash and Berg, 2003). Qualitative methods are seemed to be more appropriate for the information systems evaluation, quantitative measurement standards should be supported on qualitative data in order their meaning to be conceivable (Berg, 1999). Therefore, measuring the quantitative aspect of these systems’ improvements is difficult (Chin and McClure, 1995).

Qualitative methods take into account experiences, emotions, and human-interaction processes and are appropriate to be used during the formative stage of system development (Currie, 2005). Qualitative evaluation is also useful in cases with socio-cultural or political implications and in cases where changes in tasks, roles and responsibilities have been emerged (Berg, 1999).

Qualitative methodologies are now being seen as methods that might generate a closer approximation of the validity. Qualitative processes bring researchers closer to the truth of a domain via the subsequent rich and detailed analysis of the human experience (Currie, 2005).

The objectivist approach is defined as the method “that employ quantitative measurement and emphasise experiments” (Friedman and Abbas, 2003). According to Moehr (2002), the objectivist approach is described through the following proceedings:

- Study question definition
- System’s investigation definition
- Measurement methods and instruments selection
- Demonstration study design
- Demonstration study management
- Results analysis.

However, the objectivist approach has serious practical and scientific milestones for the evaluation of information systems in health care.

The subjectivist approach concerns “the scientific methods that employ qualitative observation of phenomena as they occur naturally” (Friedman and Abbas, 2003). Moehr (2002) in his study demonstrated that the subjectivist approach concentrates to:

- User’s requirements and queries,
- User’s perceptions for the effects of the information system and the environment in which will be applied,
- Careful, detailed and sensitive observations,
- Inductive reasoning for understanding the circumstances and conditions for application, and
- Addressing the problem from a different set of premises.

Therefore, according to Moehr (2002), the identical evaluation methodology in health informatics includes the subjectivist approach quantifiable and the objectivist approach with more realistic requirements and its drawbacks compensated by the subjectivist method.

1.5.4.3. Randomised Controlled Trials

Evaluation in medical informatics combine the medicine, informatics and technology’s discipline (Talmon et al., 1999) and has the tendency to follow the model of controlled clinical trials, which uses a number of assumptions with unexamined implications (Forsythe and Buchanan, 1991). However this tendency, randomised clinical control trials (RCTs) are not indicative for evaluation with multiple groups participating to the evaluation process (Kaplan, 2001).
The randomised controlled trial (RCT) is the current gold standard for informatics and biomedical evaluation as preserves rigid objectivity and controls irrelevant effects (Currie, 2005). However, this method is not appropriate to answer the “when” and the “how” the systems will be used (Kaplan, 2001). The RCT, as an evaluation method cannot justify the resources required for the introduction of an information system (Moehr, 2002); is unable to capture information required for effective system development during the formative development process (Currie, 2005). Instead, the RCT is a suitable intervention that can and should be used for summative evaluation (Currie, 2005).

On the other hand, the RCT is the only reliable method for the size estimation of small but valuable benefits of any kind of interventions, such as testing new drugs, surgery and other procedures, as well as for the estimation of the frequency and severity of their side effects (Moehr, 2002; Wyatt and Wyatt, 2003).

1.5.5. Models Referred for Evaluation

1.5.5.1. The Socio-Technical model

The socio-technical model of evaluation, as a user-oriented approach, supports that the systematic prognosis and discernment in the daily work practices in which the information systems will be applied, should precede the design and implementation (Berg, 1999). The purpose of such a model is to guarantee quality assurance in medical practice (Harteloh, 2003).

A socio-technical appraisal is possible in case of different outcomes from evaluating information sharing, as a social process, in which technical and social aspects are strongly interconnected (Aarts and Berg, 2004). Although this model is complex (Marx and Slonim, 2003), a socio-technical requirement analysis assists the system’s developers to shape a detailed description of the environment surrounding this computer system, emphasising the awareness and coordination among users in their workplace (Reddy et al., 2003). It is therefore worth mentioning that research is mandatory in order to show the importance of
socio-technical issues, such as leadership, clinician motivation and communication (Ash and Berg, 2003).

1.5.5.2. The Technology Acceptance Model

The Technology Acceptance Model (TAM), and the Information Technology Acceptance Model (ITAM) afterwards, was identified by Davis (1989) and was based on the perceived usefulness and perceived ease of use factors of user technology acceptance. This model focuses on the user as individual (Dixon, 1999) predicting and examining the factors that will lead users to either accept or reject an information system (Despont-Gros, Mueller and Lovis, 2005). For the achievement of this target, the model demonstrates the aspects (constructs) where evaluation can be applied (Dixon, 1999), measuring information system’s usefulness and ease to use (Despont-Gros, Mueller and Lovis, 2005).

Analysis at the individual level has been the prevailing evaluation perspective (Southon, Sauer, and Crant, 1997). Yang and Yoo (2004), based on Davis’s TAM, found in their study that cognitive attitude is an important variable to explain behaviours regarding information system’s usage. On the other hand, Legris, Ingham and Collerette (2003) supported in their study that although TAM is a useful model, it should be integrated into an innovative one, including human and social change aspects.

1.5.5.3. The Task Technology Fit Model

The Task Technology Fit (TTF) model focuses on performance (organisational and individual) and is a theoretical perspective, interesting for user evaluation. TTF is supported by the hypothesis that a better combination between user’s needs and technology leads to the better performance (organisational and individual), where users themselves can evaluate the level of this combination (Despont-Gros, Mueller and Lovis, 2005).
1.5.5.4. Disconfirmation Theory and Dissonance Theory

Both these theories are based on the term that satisfaction reflects the gap between the performance and the expectation about an information system (Despont-Gros, Mueller and Lovis, 2005).

The dissonance model supports that the unfulfilled expectations of users from an information system create dissonant ideas that have to be minimised in order users to maintain consistency to the adoption of satisfaction from their prior expectations (Despont-Gros, Mueller and Lovis, 2005). Additionally, Liberman and Förster (2005) showed in their study that dissonance theory reduces post-decisional spreading of alternatives in cases of repeatable decisions difficulty.

On the other hand, “the disconfirmation theory predicts satisfaction by expectations perceived by individuals, perceived performance and perceived disconfirmation; unrealistically high expectations result in lower levels of perceived benefit than those associated with realistic expectations (Staples, Wong and Seddon, 2002). The expectancy disconfirmation theory (EDT) has been successfully used to predict users’ intention to continue using information technologies. Chiu et al. (2005) proposed an EDT model to examine users’ cognitive beliefs.

1.5.5.5. Despont-Gros, Mueller and Lovis Model for User Evaluation

Despont-Gros, Mueller and Lovis (2005), proposed a model concerning the interactions between the user and the clinical information system (CIS), on the human-computer interaction (HCI) basis. This model was refined by existing models and studies and is focused on user evaluation. Furthermore, it shows the complexity of the following aspects:

- **Information system’s characteristics**, including input-output devices, dialogue techniques, computer graphics and architecture
- **Human/user characteristics**, such as attitude towards innovation, level of use, amount of use and demographic data.
- **Context of use and environment characteristics.** For the adoption of a new CIS, the context of its use, communication patterns and manipulation of other existing tools have to be taken into account.

- **Development process characteristics,** involving design, implementation and evaluation’s characteristics, during which user participation and involvement are really important.

- **Impact or outcome of computerisation.**

  All these aspects contribute to user acceptance and reflect user’s perceptions (Despont-Gros, Mueller and Lovis, 2005).

### 1.5.5.6. Validation of Telematic Applications in Medicine Guidelines

Validation of Telematic Applications in Medicine (VATAM) guidelines is a synthesis of existing methods and methodologies assessing of telematics applications in medicine. Its main purpose is to provide the proper approach regarding assessment of information and communication technology in health care to all potential users, focusing mainly on the questions, in the early stages of evaluation that need to be answered before the assessment study design (Talmon *et al.*, 1999). Validation guidelines represented in a usable, easy to access and informative way, are beneficial for all stakeholders in health telematics projects (Nykänen *et al.*, 1999).

### 1.5.6. Problems in Evaluation of Information Technology in Health Care

#### 1.5.6.1. Insufficient Evaluation Methods, Guidelines and Tools

One of the main barriers to evaluation is the absence of sufficient evaluation methods, guidelines or tools, combining the technical, the organisational and the social issues regarding the health information systems (Ammenwerth *et al.*, 2004). Resources or other means to undertake evaluation studies are difficult to be found (Rigby, 2001), as there is lack of resources for post-project assessment or studies that are done may not be published (Friedman and Haug, 2003).
1.5.6.2. Complexity of Evaluation Object

According to Ammenwerth et al. (2003a), the evaluation object of health information systems is complex and broad due to the fact that concentrates not only on hardware and software, but also on the information processing. Therefore, evaluation necessitates the computer technology understanding combined with the social and behavioural processes. Even if the introduction period is passed, the evaluation object may steadily being changed (moving evaluation target) (Ammenwerth et al., 2003a).

Friedman and Haug (2003) have additionally stated the following barriers as responsible for the complexity of the system's evaluation:

- Diversity of population regarding the system's evaluation (stakeholders, developers, evaluators),
- Multiple factors which influence effects and are difficult to generalise,
- The changing environment confounds any evaluation: both the system being evaluated and outside factors are changing the way users are doing their work,
- Prolonged period of evaluation until the completeness, in such degree that the project is changed by the time evaluation is complete,
- Due to the continuous changes in the field of informatics, there is the concern that as soon as the instruments for the evaluation are found, they may not be any longer useable.

Furthermore, the effects of an information system may be varied in several departments due to the different factors emerged in these departments, influencing the results of the evaluation study (Ammenwerth et al., 2003a).

1.5.6.3. Conflicting Evaluation Questions

On the other hand, information technology evaluation becomes more composite due to the insufficient cooperation among the researchers from different academic fields and traditions, the different professional groups within the hospital and the reliance on aspects such as legislation or economic limitations (Ammenwerth et al., 2003a). Therefore, the evaluation questions may
become conflicting, regarding economic, sociologic, psychological, organisational, technical, information logistical or clinical aspects, driving to different and quite complex study designs and evaluation methods, difficult to manage with limited resources in a given period of time (Ammenwerth et al., 2003a). For that reason, the creation of clearly defined norms is quite intangible and consequently, indirect measures, such as user satisfaction, are often applied, resulting to an incomplete definition of information technology's benefits (Ammenwerth et al., 2003a). In many cases, information systems are not sufficiently integrated, such as in the case of Kenya’s District health systems, in which information systems were incoherent with no effective central co-ordination to ensure availability in the information flow (Odhiambo-Otieno, 2005).

1.5.6.4. Funding and Number of Participants

Furthermore, in order an evaluation study to be accomplished, two variables are mandatory: sufficient funding and sufficient number of participants. Insufficient number of participants complicates the result extraction of the quantitative measures (Zielstorff et al., 1997).

It is therefore worth mentioning that without stakeholders’ support and motivation, the sufficient resources and number of participants in IT evaluation studies are difficult to be found (Ammenwerth et al., 2003a). According to Friedman and Haug (2003), in many cases the members of the organisational management does not aim to evaluation studies, as they are afraid of:

- The possibility that the project will not be beneficial for the hospital,
- The budget may be insufficient for further activities, in case of a beneficial project, and
- The presence of new needs identified from evaluation studies.

A clinical information system and a hospital information system as well may cause harm as well as benefit (Friedman and Haug, 2003). However, in case of unexpected adverse effect the subsequent factors should be assessed and corrected rather than continue funding to attempt results. If fundamental
underlying factors are not corrected and deeper analysis has not estimated as necessary, the project will still fail but in additional cost (Littlejohns et al., 2003).

It is hard to distribute the IT cost accurately and there is lack of methodology for financial evaluation (Friedman and Haug, 2003). Necessarily, the high cost and the high level of risk of information systems themselves are factors that seriously should be taken into account, as the large-scale information systems’ application have a 30% failure rate (Southon, Sauer, and Crant, 1997).

1.5.6.5. Conflicts

However, there are conflicts in understanding between those who commit the system, the developers and users, which should be adequately appreciated (Littlejohns et al., 2003). HIS stakeholders from the one side and developers from the other side, should control and manipulate their perceptions and expectations for information systems development due to the increasing possibility of system failure if their expectation are unrealistic and cannot be stepped with the existing health care environment (Heeks, 2005b). Entrepreneurs should be capable to take a detached view of the cost effectiveness of the intervention (Littlejohns et al., 2003). In many cases, users’ information requirements are not taken seriously into account, resulting to the creation of irrelevant systems to the potential users (Odhiambo-Otieno, 2005). Therefore, systems that do not take into account social and professional cultures and underestimate the complexity of routine clinical and managerial processes, are prone to failure (Littlejohns et al., 2003).

1.5.6.6. Organisational Resistance

In many cases, organisational management perceives evaluation study as a secondary priority or the evaluation contribution is not valued and therefore prefers to support funding for other studies more “imperative”. In other cases, there is a weakness to detect and realise the failures or the mistakes of the system or managers do not want to see their decisions to be evaluated (Ammenwerth et al., 2004). Though, the complexities of organisational factors
should be approached in a more sophisticated way (Southon, Sauer, and Crant, 1997).

1.5.6.7. Training- Education of Health Care Professionals

In case of the introduction of an information system, users need a lot of time to become familiar with this system and fully adopt it (Ammenwerth et al., 2003a). Due to the tremendous development in health information systems, educational courses and even programs are needed, in order health care professionals to be informed and well-educated and able to support these systems in their daily (Heeks, 2005a). On the other hand, Feied et al. (2004) support that each prospective information system is preferred to be applicable for basic clinical functions with little or no formal training. An information system, which demands intensive training in order to be used, may lead to productivity problems, which are indicated as poor designed systems (Feied et al., 2004). However, due to continuous technology implementation, the on-the-job technological training of the staff should be provided (Li and Benton, 2005). Staff should be trained in techniques for information production and use (Odhiambo-Otieno, 2005) in the introduction phase. Cases have been reported that educational efforts that took part late during the implementation phase have contributed to system’s failure (Littlejohns et al., 2003).

1.5.6.8. Methodological Issues

One of the main methodological barriers is the lack of access to easy methodologies (Friedman and Haug, 2003). Evaluation studies are often not based on theory sufficiently, are inadequately implemented (Ammenwerth et al., 2004) or existing methods from relevant fields, such as psychology, are not used (Friedman and Haug, 2003). On the other hand, evaluators are often not sufficiently trained and therefore are incapable to select the appropriate methods for the specific case they are asked for (Ammenwerth et al., 2004) and identify the target of evaluation (Friedman and Haug, 2003).
1.5.7. Recommendations

1.5.7.1. Insufficient Evaluation Methods, Guidelines and Tools: Recommendations

Guidelines for evaluation should be widely available, in order to strengthen future evaluation studies and their necessity, not only towards the medical informatics community, but also towards other individuals dealt with health information systems and health care delivery (Ammenwerth et al., 2004). The availability of case studies where evaluation has actually influenced decisions (positive and negative studies) (Friedman and Haug, 2003) via evaluation centers, via established networks supporting the exchange of experience, or via broadly accessible warehouses (Ammenwerth et al., 2004) would be enormously beneficial.

1.5.7.2. Complexity of Evaluation Object: Recommendations

The evaluation object should be focused on specific aspects of the system and study questions should be defined after a thorough discussion and agreement regarding the evaluation targets and criteria (Ammenwerth et al., 2003a). Due to the complexity of the evaluation object the creation of a group of evaluators who are cross-trained in informatics and evaluation, and are therefore able to perceive at least the intrinsic evaluation complexities would be advantageous (Friedman and Haug, 2003).

1.5.7.3. Conflicting Evaluation Questions: Recommendations

The introduction of new evaluation questions may appear during the study, but only in case that they will not cause conflicting problems (Ammenwerth et al., 2003a).

1.5.7.4. Number of Participants and Funding: Recommendations

As far as for the adequate number of participants in the evaluation study, the liable management should be motivated and the prospective participants could
be methodically guided, providing the opportunity for development (Ammenwerth et al., 2003a). For clinical trials, multi-centric studies are under consideration due to the availability of the large number of participants, but under cautiousness for the difficult study design and the variation between study participants among the several centre trials (Ammenwerth et al., 2003a).

Evaluation should be sufficiently funded during the planning, development, implementation and operation of HIS (Ammenwerth et al., 2004). Friedman and Haug (2003) support that a fixed percentage (approximately the 10%) of the total budget for the IT’s development expenses should be pre-allocated for evaluation.

1.5.7.5. Conflicts: Recommendations
Evaluation studies should be performed by professional expertises independently of any conflict and unbiased by any political, managerial or other kind of pressure, in order to answer the evaluation questions, which have been set (Ammenwerth et al., 2004).

1.5.7.6. Training- Education of health care professionals: Recommendations
In many cases, system’s failure is resulted by the managers and developers’ responsibility to look for and learn from lessons from past projects (Littlejohns et al., 2003). System’s evaluation should be based on a variety of approaches and methods (Ammenwerth et al., 2004) presenting an overall view (Littlejohns et al., 2003) and target in providing a comprehensive and accurate picture of the health situation in the hospital environment. In order this target to be accomplished, developers and managers should collect information from other health care providers with similar operational infrastructure (Odhiambo-Otieno, 2005) or should be aware of the systems that competing organizations had adopted (Grover, Jeong and Segars, 1996). Additionally, every new manager should be trained to adopt the evaluation’s survey results and invent strategies in accordance with user requirements’ and user satisfaction’s ratings (Li, 1997).
1.5.7.7. Methodological Issues: Recommendations

Firstly, the information technology, as well as the environment in which it will be applied and any aspect that may influence the information technology implementation should be described elaborately (Ammenwerth et al., 2003a). Additionally, all the changes emerging during the evaluation and their interaction with users should be documented thoroughly (Ammenwerth et al., 2003a).

It is also worth pointing out that the ‘evidence-based informatics’ helps put science into the field (Friedman and Haug, 2003). Additionally, the evaluation should follow a long-term plan in order users to integrate the new information technology, taking into account the learning period during the introduction stage and the changes that may occur in the moving evaluation target (Ammenwerth et al., 2003a). Therefore, attention should be paid in project teams overseeing the extended programmes to be in post for the whole period, otherwise projects will be stepped back (Littlejohns et al., 2003). On the other hand, the development of new flexible methods for evaluation, using qualitative techniques and allowing studies to be done quickly would accommodate to effective time saving (Friedman and Haug, 2003).

Friedman and Haug (2003) proposed in their study, as far as for overcoming methodological barriers in evaluating health care information systems, the creation of an evaluation portal that includes:

- ‘Packaged’ approaches to evaluation with relevant text materials that explain how to use the tools,
- Evaluation instruments that have been validated and used in other studies, and
- Completed reports and case studies (positive and negative).
1.5.8. Information System Effectiveness and Success

The main criteria for measuring information system effectiveness include system’s usage, user information satisfaction, quality of decision-making, productivity from cost benefit analysis and system quality. From the above criteria, system usage and user satisfaction are more eminent measures (Southon, Sauer, and Crant, 1997). To measure the effectiveness of a medical information system, the processes that reflect the effects should be formed in an articulate way in order to be analysed during the evaluation research (Kaplan, 1997). On the other hand, in order a system to be successfully implemented, developers should assume whether users will use the system or not, in accordance to the past usage and the external and internal factors influencing the usage of the information system (Bajaj and Nidumolu, 1998).

Delone and McLean’s classification (1992) for information system effectiveness and success consists of six elements (system use, user satisfaction, system quality, information quality, individual and organisational impact). The above model also supports that the relation between system quality and information quality leads to system use and user satisfaction and furthermore, that use and satisfaction encourage an individual impact, which further leads to the organizational impact (Despont-Gros, Mueller and Lovis, 2005).

Based on the above, Southon, Sauer, and Crant (1997) have further developed a model for the measurement of information systems’ effectiveness, consisted of the following aspects:

- Performance assessment (evaluation referent),
- Unit of analysis at the organisational as well at the individual level,
- Evaluation type (process, response and impact).

User involvement is a determinant to system’s success (Igbaria and Guimaraes, 1994). At this point of view, the role of users must be carefully considered and more cost-efficient practices are needed for gathering users’ implicit needs and requirements (Kujala, 2003). However, user involvement and
influence in large organizations’ IT development may be impractical (Gefen and Ridings, 2003).

The most recent HIS Working Group (Heidelberg, Germany, April 2002) underlined that people ultimately determine the success of a HIS, with a strong emphasis on the sociological, behavioural, and ethical aspects of the HIS (Giuse and Kuhn, 2003).

### 1.5.9. User Acceptance

As Collins’ dictionary defines (p.8), “acceptance of something that you have been offered is the act of agreeing to use it”. On the other hand, Despont-Gros, Mueller and Lovis, (2005) defines information system’s acceptance “as an attitude of users towards an information system or an information technology. It is a multifactor construction based on an affective and cognitive evaluation of all components surrounding and influencing the interaction process between a user and an information system”.

User acceptance is characterised as an important part of development and evaluation of information systems (Davis, 1993). Due to the increase of information technology adoption in hospitals, physicians and nurses claim for the access and management of information to become easier through these systems (Beuscart-Zephir et al, 1997). The boundary between users and IT personnel (Gefen and Ridings, 2003) and the resistance by managers (Davis, Bagozzi and Warshaw, 1989) often reduce the possibility the installed IT to be accepted by the users.

User acceptance seems to assist in system’s problem identification. Therefore, the reasons that users accept or reject the systems should be defined, in order to predict, explain and increase user acceptance (Davis, Bagozzi, and Warshaw, 1989). According to Doll and Torkzadeh (1988) it is more useful to measure the frequency and the level of the usage of the several functions (width of use), rather than the number of people that use the system. Travers and Downs (2000) referred that the differences among user acceptance or user declination regard organizational cultures, users’ relationship with practices and post-
implementation experiences, as far as the emerging or no of benefits from system usage.

Many researchers demonstrate user acceptance as reflection of user and developer’s characteristics harmonisation into the system’s implementation (Despont-Gros, Mueller and Lovis, 2005). User acceptance plays an important role to the successful adoption of the information system (Despont-Gros, Mueller and Lovis, 2005).

User acceptance studies should preferably apply a pre-test and a post-test design in order to the comparison and the confirmation of collected data before and after the implementation of systems respectively (Aydin, 1994). Ammenwerth et al (2003b) appraised the introduction of a computer-based nursing documentation system in a pretest–posttest intervention study, concentrating on a questionnaire developed using items from published questionnaires and items that had been grown for the purpose of their study.

The acceptance of the technological tools seems to be in greater levels in the young groups of health professionals. Mikulich et al. (2001), found that the seventy five percent of physicians who implemented the examined information system graduated from the medical school after the 1990, emphasising the user acceptance in the young group of doctors. According to Brumini’s et al. study (2005), younger users with computer science education and with previous computer experience were more positive towards computers than others.

Users' opinion for the implemented information system seems to play a critical role. Relevance, validity, and work are the three important parameters in describing the way that the users experience the system (Karlsson et al, 1997). Gadd et al. (1998) used a multi-method formative evaluation to assess clinicians' views as far as for system’s usability and usefulness. Ahearn and Kerr (2003) used focus groups to examine the disadvantages and advantages of using prescribing decision support systems, as well as ways for future improvements in these systems.

The health care professionals do not feel that information technology decreases their initiatives in decision-making, as Gardner and Lundsgaarde
(1994) reported in their research regarding physicians and nurses’ attitudes, using the Health Evaluation through Logical Processing (HELP) clinical information system.

In addition to the latter key determinants, users' perceptions concerning stakeholders’ support and the level of organisational support for the system implementation are also referred as determinants for user acceptance (Venkatesh et al, 2003).

1.5.10. User Satisfaction

According to Collins dictionary’s definition (p.1286), “satisfaction is the pleasure that you feel when you are doing or have done something that you wanted or needed to do”.

User satisfaction is one evaluation mechanism for determining system success (Wu and Wang, 2005), or may acts as a subjective measure of information system’s success (Despont-Gros, Mueller and Lovis, 2005). Additionally, as has been mentioned before, user satisfaction is also used as success’s surrogate (Li, 1997; Despont-Gros, Mueller and Lovis, 2005).

According to the results of Doll and Torkzadeh’s survey (1988) the five components for end-user satisfaction’s measures are content, accuracy, format, ease of use, and timeliness. In Zielstorff’s et al. (1997) project, although preliminary results show no effects on knowledge and clinical decision-making skills, the system was rated positively for user satisfaction. Bailey (1990) described a technique included extensive empirical tests and comparison standards for hospital computer user satisfaction, in order to measure and manage user approaches through the aspects of computer systems and therefore to encourage the effectiveness of those systems. Dupuits and Hasman (1995), based on Bailey’s approach, found that user satisfaction is closely correlated with the way that software works and facilitates its users.

User satisfaction and user attitude are especially correlated, as the latter is the affective evaluation of the system by its user (Barki and Hartwick, 1994). Bindels et al. (2003) investigated generals’ practitioners attitudes based on their
experiences, underlining the attention that has to be paid to the promotion and
the adoption of the accepted national and regional guidelines, and the motivation
of an optimistic attitude in the direction of the practice guidelines among the
users in the daily practice. It is also worth mentioning that user satisfaction
among the users in several departments is fluctuated, due to the differences in
working processes in these departments (Ammenwerth et al., 2003c).

1.5.10.1. Variables Affecting User Satisfaction

According to Bailey and Pearson’s (1983) information system success
instrument, user satisfaction is affected by:

- Top management’s interest, support and participation,
- User’s confidence and certainty about the systems provided,
- User’s participation toward the functioning of the computer-
  based information systems and services.

Li (1997) has added to the former variables of Bailey and Pearson’s
instrument the support of productivity tools, emphasising that the quality and the
quantity of the computer software, hardware and peripheral devices, which
support organisation’s functions, as an important factor for user’s satisfaction.

In studies regarding the assessment of attitudes, physicians are consent that
care combined with information technology is better than standard care (Mikulich
et al., 2001) and are willing to adopt an innovative information system only when
their effort for the implementation could have an additional value improving their
productivity and performance (Vlahos and Ferratt, 1995), and efficacy of the
workflows without adverse effects in patient care (Gadd and Penrod, 2001).

User satisfaction is affected by perceived benefit and expectations
characteristics such as perceived usefulness, ease to use and user expectations.
Ease to use is important but usefulness is much more important (Davis et al.,
1989). On the other hand, Davis, Bagozzi, and Warshaw (1989) reported in their
study that perceived usefulness influences peoples’ intentions strongly, where
perceived ease of use effects slightly on their intentions.
Expectations on a system should be kept to a realistic level. Users with unrealistic expectations when they get an accurate picture of the information system, they become dissatisfied and may discontinue using the system (Szajna and Scamell, 1993).

User satisfaction is affected by user background, experience, skills and involvement (Mahmood, et al., 2000), as the way users deal with computer technology is a core key to the success or failure of the whole system (Grémy, 2005). At this point, user participation and user involvement have to be distinguished. User involvement regards the importance and personal relevance of a system to its user (Barki and Hartwick, 1994) and the perception that user should be included in the development process (Despont-Gros, Mueller and Lovis, 2005). User participation concerns the activities performed by the user during the development process (Barki and Hartwick, 1994; Despont-Gros, Mueller and Lovis, 2005).

User involvement affects positively the user satisfaction (Kujala, 2003). On the other hand, user participation and user satisfaction during system development are significantly correlated (McKeen and Guimaraes, 1997), due to a sense of contribution and supervising, undertaking initiatives toward the system and better understanding of system’s capabilities (Baroudi, Olson and Ives, 1986).

1.5.11. Questionnaires as Measure for User Satisfaction

The questionnaire seems to be a valid and reliable measure for user satisfaction (Baroudi and Orlikowski, 1988; Ammenwerth et al., 2003c). To appreciate the usability of an information system it is important to measure user satisfaction in addition to its effectiveness and efficiency. There are modular questionnaires for user satisfaction, such as the Questionnaire for User Interaction Satisfaction (QUIS), the Software Usability Measurement Inventory (SUMI) and the System Usability Scale (SUS) (Table 6).
<table>
<thead>
<tr>
<th></th>
<th>Measurement</th>
<th>Factors measured</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUS</strong></td>
<td>User satisfaction with</td>
<td>• User satisfaction with software.</td>
<td>10-item scale questionnaire (1).</td>
</tr>
<tr>
<td>(System Usability</td>
<td>Subjective assessments of</td>
<td>• Subjective assessments of usability.</td>
<td></td>
</tr>
<tr>
<td>Scale) (1)</td>
<td>software.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• User satisfaction with software (1).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subjective assessments of usability (1).</td>
<td></td>
</tr>
<tr>
<td><strong>SUMI</strong></td>
<td></td>
<td>Scores the measurement factors against expected industry standards.</td>
<td>50 item questionnaire.</td>
</tr>
<tr>
<td>(Software Usability</td>
<td></td>
<td>• Likeability,</td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>Measurement Inventory)</td>
<td>• Efficiency,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Helpfulness,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Control and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Learn-ability</td>
<td></td>
</tr>
<tr>
<td><strong>QUIS</strong></td>
<td></td>
<td>Assessment of user’s subjective satisfaction combined with</td>
<td>Similar to SUMI.</td>
</tr>
<tr>
<td>(Questionnaire</td>
<td>Screen factors,</td>
<td>• Terminology and system feedback,</td>
<td>Demographic questionnaire.</td>
</tr>
<tr>
<td>for User</td>
<td>Learning factors,</td>
<td>• System capabilities,</td>
<td>Measurement for overall user satisfaction</td>
</tr>
<tr>
<td>Interaction</td>
<td>Technical manuals,</td>
<td>• On-line tutorials,</td>
<td>along six scales.</td>
</tr>
<tr>
<td>Satisfaction)</td>
<td>Multimedia,</td>
<td>• Voice recognition,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Virtual environments,</td>
<td>• Internet access,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Software installation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Questionnaires for user satisfaction measurement

Sources: (1) Brooke, 1996 (2) Harper and Norman, (3)
2. MATERIALS AND METHODS

2.1. MATERIALS

2.1.1. Kavala Hospital

The peripheral hospital of Kavala is stated at the Kavala city. The departments of the hospital are the follows:

<table>
<thead>
<tr>
<th>Health Care Departments</th>
<th>Administrative Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A' Pathological</td>
<td>Personnel Department</td>
</tr>
<tr>
<td>B' Pathological</td>
<td>Secretarian</td>
</tr>
<tr>
<td>A' Pulmonary</td>
<td>Admission Office</td>
</tr>
<tr>
<td>B' Pathological</td>
<td>Financial Management</td>
</tr>
<tr>
<td>Cardiological</td>
<td>Department of computer science</td>
</tr>
<tr>
<td>Neurological</td>
<td>Nutritional</td>
</tr>
<tr>
<td>Pediatric</td>
<td>Warehouse Department</td>
</tr>
<tr>
<td>Reumatological</td>
<td></td>
</tr>
<tr>
<td>Dermatological</td>
<td></td>
</tr>
<tr>
<td>A' Surgical</td>
<td></td>
</tr>
<tr>
<td>B' Surgical</td>
<td></td>
</tr>
<tr>
<td>Department of Thoracic Surgery</td>
<td></td>
</tr>
<tr>
<td>Orthopaedic</td>
<td></td>
</tr>
<tr>
<td>Urological</td>
<td></td>
</tr>
<tr>
<td>Ophthalmological</td>
<td></td>
</tr>
<tr>
<td>Anesthesiological</td>
<td></td>
</tr>
<tr>
<td>Midwifery and Obstetrics</td>
<td></td>
</tr>
<tr>
<td>Neurosurgical</td>
<td></td>
</tr>
</tbody>
</table>

In all the above departments hospital information system is applied except the Psychiatric department. However, the structure of the information system is in very early stages. In health care departments it is applied only for drug ordering. For that reason, users in each of the health care departments are only the head nurse and the alternate head nurse. In the administrative department all operations are implemented through the information system of the hospital. Yet, in these departments many non-users exist, mainly because of they old and have no IT education.

For the purpose of this study 241 persons working in the hospital were asked whether they used the HIS or not. Sixty-three of them were occupied at the administrative department of the hospital and the rest 178 were health professionals. The percentage of the users that denied taking part to the study was very small (7,8%).
The overall of the users participated to the study was in total sixty-four. Forty-three of them were administrative employees (administrative group) and twenty-one health professionals respectively (health care group).

To the degree of the percentages of the non-users, 27% of the administrative employees and 88.1% of the health care professionals were non-users of the HIS.

2.1.2. System Usability Scale

During this study, the System Usability Scale (SUS) questionnaire was used. This questionnaire is designed only for the users of the system. Subjects were asked to complete a paper-based form of SUS given to them hand-to-hand, translated to the Greek language and attached with the consent form.

The SUS was designed by Brooke (1996) in order to measure the usability of a system. It is a simple, ten-item high-levelled scale assessing a variety of aspects of system usability subjectively and is freely available for usability assessment in a variety of research projects and industrial evaluations (Brooke, 1996).

One of the main reasons that SUS questionnaire has been selected is that this questionnaire is simple, flexible and covers many aspects as far as for usability of system in order to evaluate user satisfaction. It is also worth-mentioning that this questionnaire has not been used for evaluation of hospital information systems.

2.1.2.1. Using the System Usability Scale

According to its creator, when using the SUS questionnaire the following things should be taken into account:

- Respondents should not think for a long time what to check. The immediate response is valuable.
- All items should be checked.
- If respondents are not sure what to response to a particular item, they should mark the centre point of the scale.
2.1.2.2. Scoring the System Usability Scale

According to Brooke (1996), the calculation of the SUS score is demonstrated as follows:

- Each item's score contribution will range from 0 to 4.
- For items 1,3,5,7, and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position.
- The score contributions from each item are summed.
- The above sum is multiplied by 2.5. The result from this multiplication is the overall value of SUS.
- SUS scores have a range of 0 to 100.
- Scores of each item separately are pointless on their own.

2.1.3. Consent Form and Information Sheet

According to Helsinki’s declaration, an information sheet and a consent form were given to all subjects. The above were written in the Greek language for the convenience of the respondents. The participants were firstly informed about the purpose of the study both orally and reading the information sheet. The participation was limited to that specified in the information sheet. All the subjects agreed signing the consent form to participate in the filling of the questionnaire.

As was stated to the consent form, the subjects were free:

- to ask questions concerned of the study and the given information sheet, and
- to withdraw at any time, without giving any reason and without their legal rights being affected, as their participation was voluntary.

Additionally, as far as concerning the consent form, the subjects had the opportunity either to agree or disagree to take part to the study and allow any responsible person, relevant to the specific research, to look any of the information that the subject would transfer.
2.2. METHODS

2.2.1. Data Protection

All the data collected for the study kept in a safe place locked. The records may be transferred only in E.U. countries. The results may be published in a Greek or an international journal or conference by all means, without transgressing the anonymity of subjects. The anonymity was secured by using index numbers.

2.2.2. Selection Criteria

All the persons asked whether they used the hospital information system or not. Initially two hundreds forty-one subjects kindly asked to participate to the study. One hundred and ninety eight subjects excluded from the filling of the questionnaire, as they were non-users. Therefore, only the users of the system, either health professionals or administrative staff, filled the questionnaire.

2.2.3. Statistical Methods

The person responsible for the collection and the statistical evaluation of the data was Chiotaki Nikomacheia. The statistical package used was SPSS 12.0. The statistical methods used were descriptive statistics, bivariate correlations and non-parametric tests.
3. DATA ANALYSIS

3.1. SUS Score

SUS questionnaire data also suggests that subjects themselves rated the system as being fairly usable, with an SU score of 67.305 and SD of 13.46. The SUS score in the health care group most commonly varied between 61-80% in the 66.7% of its individuals. Additionally, 14.3% of the health care users scored the questionnaire between 81 to 100% and another equal percentage of the same group scored between 41 to 60%. Finally, a small percentage (4.8%) scored between 21 to 40%. None of them scored between 0-20 percent.

As far as for the administrative group, the majority of its individuals (53.5%) scored also between 61-80%. The percentage that scored 81-100% is equal to 11.6%. On the other hand, a many respondents (30.2%) scored between 41-60%. Finally, none of respondents scored 0-20% and 4.7% of the respondents scored 21-40%.
Figure 1a: SUS score in the health care group

Figure 1b: SUS score in the administrative group
3.2. Frequency of Use

The statistical evaluation of the data revealed that health professionals (n=21) would strongly prefer to use the system frequently in the 66.7% of the cases (Fig. 1a). These results are significant (p<0.01). Nevertheless, it is interesting that 80% of the health care users would prefer to use the system frequently. The latter results are also significant (p<0.01), using the Chi-square statistical test but imprecise because of the wide 95% confidence interval [95% CI=(0.642,0.978)].

Similar results are observed also for the administrative users (n=43); over the half of them would strongly desire to use the system regularly. The administrative group in a percentage equal to 70% tended to the preferable frequent use (Fig. 1b). These results were also significant (p<0.01) as resulted from the use of the Chi-square statistical test, but imprecise due to the wide 95% confidence interval.
Fig. 2a: Frequency of use in health care group

Fig. 2b: Frequency of use in the administrative group
3.3. Complexity

Concerning the complexity of the system, the 42.9% and of the health care professionals totally disagreed and an additional proportion equal to 23.8% disagreed that the system was complex. A small part of this group also characterised the system complex (14.3%). Moreover, a significant percentage (19%) had no specific opinion (Fig.2a). These results are not significant when performing test statistics.

Likewise, approximately half of the administrative employees totally disagreed and in addition the 16.3% of them disagreed that the system was complex. Only the 10% of the administrative users consider the system as complex. It is also worth-mentioning that approximately the 30% of them neither found it complex nor simple (Fig. 2b). These results are significant (p<0.05), but the confidence interval is very wide.

Nevertheless, it is interesting that the 66.7% of the health care professionals and the 62.8% of the administrative group in total disagree that the system is complex.
Complexity

Fig. 3a: Complexity in health care group

Fig. 3b: Complexity in the administrative group
3.4. Easy to Use

The health related professionals in 38.1% of the group have defined that the system was no easy to use, as they had thought. In contrast, the 29.4% of the same group, found the system easy to use. It is worth-mentioning that a great percentage of health care users (33.3%) found the system neither easy nor difficult to use (Fig. 3a). According to Chi-square test, these results have no statistical significance.

Similarly to the previous results, approximately the 30% of the administrative users thought that the system was easy to use, while on the other hand, the 41.9% of users disagreed with this statement. However, around the 30% of this group neither agrees nor disagrees whether the system was easy to use, as they perceived or not (Fig. 3b). Likewise to the health care group, these results are not statistically significant.
Fig. 4a: Easy to use in health care group

Fig. 4b: Easy to use in the administrative group
3.5. Need for Support from Technician

One in two of the users in the health care group did not believe that the support from a technician is necessary in order to be confident to use the system. However, the largest percentage of users of the same group (38.1%) had no specific opinion on this statement. The remaining 14.3% considered the support and the guidance from a technician as important (Fig. 4a). These results in accordance to Chi-square statistical test are insignificant.

The majority of the administrative employees (37.2%) supported strongly the opinion that technician’s support is pointless. On the other hand, over the 30% of the administrative users stated that the support from a technician is essential. It is moreover considerable that over the half respondents from the administrative group judged the support from a technician as unnecessary (Fig. 4b). However, these results are statistically insignificant.
Need for Support from Technician

Fig. 5a: Need for support from technician in health care group

Fig. 5b: Need for support from technician in the administrative group
3.6. Functional Integrity

Over the half respondents from the health care group (57.1%) strongly considered the system as well integrated and a further 28.6% of respondents simply agreed with this statement. The opposite opinion was reported only in 4.8% of the group (Fig. 5a). These results are statistically significant (p<0.05) but imprecise. Although, the total proportion of the group supported that the system was well integrated was more than 85%, driving also to significant results (p<0.01), the confidence interval is fairly wide [95% CI= (1.007,0.707)] suggesting poor precision.

The greatest part of the administrative group (32.6%) strongly supported the system as well integrated. Additionally, over a quarter of the same group (27.9%) just supported the same opinion. An equal proportion of the administrative users neither agreed nor disagreed as far as for the good integration of the system. The opinion that the system was insufficiently integrated was supported by the 11.6% of the group (Fig. 5b). These results are also significant (p<0.05) but imprecise. Nonetheless, it is interesting that over 60% of the respondents of the same group supported in total the fact that the system was well integrated. The latter results are significant (p<0.01) using the Chi-square statistical test but still imprecise because of the wide 95% confidence interval [95% CI=(0.459,0.75)].
Fig. 6a: Functional integrity in health care group

Fig. 6b: Functional integrity in the administrative group
3.7. Inconsistency

Regarding the inconsistency in the system, over the half health care users (52.4%) totally disagreed. The second most common response was neither negative nor positive in 23.8% of the individuals in the same group. Finally, less than 10% of the health care participants regarded the system as inconsistent (Fig. 6a). These results were statistically significant but with poor precision. Even though over the 66.7% of the health related users supported that the system was consistent sequencing to significant results (p<0.05), these results are also imprecise [95% CI=(0.465,0.869)].

The majority of the administrative users (58.1%) believed that the system was consistent. On the other hand, 18.6% of of the respondents in the same group supported that the system was inconstant. Finally, a great proportion of the same group (23.3%) neither support nor decline the specific statement (Fig. 6b). These results are statistically significant (p<0.05) but with an inadequate precision [95% CI=(0.434,0.728)].
Fig. 7a: Inconsistency in the health care group

Fig. 7b: Inconsistency in the administrative group
3.8. Quick Learning of the System

Over the 80% of the health related users supported that the system was easy to be learned. The proportion that supported that the system was difficult to be learned rated to 14.3% (Fig. 7a). These results have a statistical significance (p<0.01). However, the confidence interval is fairly wide [95% CI=(0.693,0.927)], suggesting poor precision.

In the administrative group, the majority (65.2%) supported that the system was easy to be learned. On the other hand, the 16.3% of the respondents in the same group supported the opposite opinion. Finally, the percentage that neither agrees nor disagrees with this statement was considerable (18.6%)(Fig. 7b). The results concerning the level of easiness of the system to be learned are statistically significant (p<0.01) but imprecise due to the wide confidence interval [95% CI=(0.509,0.793)].
Quick Learning of the System

Fig. 8a: Quick system’s learning in the health care group

Fig. 8b: Quick system’s learning in the administrative group
3.9. Cumbersome to Use

In the health care group the responses were fluctuated. The 42.9% of the health related participants claimed that the system is convenient to use where the 38.1% of the individuals in the same group asserted that the system was cumbersome to use. The remaining 19% considered neither the first opinion nor the second (Fig. 8a). These results are statistically insignificant.

In the administrative group, the 65.1% of the participants supported the system as manageable to use. On the other hand, the 20.9% of the respondents in the same group agreed that the system is cumbersome to use (Fig. 8b). These results are statistically significant (p<0.01) using the Chi-square statistical test but imprecise due to the wide 95% confidence interval [95% CI=(0.509,0.793)].
Cumbersome to Use

Fig. 9a: Cumbersome to use in the health care group

Fig. 9b: Cumbersome to use in the administrative group
3.10. Confidence

The majority of the health care participants (76.2%) felt confident using the system and only 9.6% of the respondents in the same group insecure using the system (Fig. 9a). Using the Chi-square test, these results proved to be statistically significant ($p<0.01$) but with low precision due to the wide confidence interval ($95\% \text{ CI}=(0.580,0.944$)].

Similarly, most of the administrative users (69.8%) felt confident using the system whereas only 9.4% of the users in the same group disagreed with the previous statement. The remaining percentage (20.8%) felt neither confident nor insecure using the system (Fig. 9b). These results are also statistically significant ($p<0.01$) but imprecise as well [$95\% \text{ CI}=(0.561,0.835$)].
Fig. 10a: Confidence in the health care group

Fig. 10b: Confidence in the administrative group
3.11. Need to Learn Before the Use of the System

Almost the half of the health care respondents (47.6%) strongly supported that there was no need to be trained before the use of the system. Particularly, 61.9% of the users in the health care group supported that there was no need to learn a lot of things before the use of the system. On the other hand, 19% of the participants in the same group supported that the training was necessary, whereas the remaining percentage neither supported nor rejected the necessity of learning things before the use of the system (Fig. 10a). These results are proved significant using the Chi-square test (p<0.05) but the very wide confidence interval [95% CI=(0.411,0.826)] suggests very poor precision.

Although over the half of the administrative users supported that there was no need for learning things before the use of the system, a significant proportion of the same group (34.9%) claimed that the training before the use of the system is important (Fig. 10b). The results are statistically significant (p<0.05) but the 95% confidence interval is wide enough [95% CI=(0.362,0.660)], suggesting reduced precision.
Need to Learn Before the Use of the System

Fig. 11a: Need to learn before the use of the system in the health care group

Fig. 11b: Need to learn before the use of the system in the administrative group
3.12. Correlations

Using Pearson's Correlation, significant correlations were established at the 0.05 or 0.01 level in both health care and administrative groups.

As far as in the health care group, confidence and functional integrity have a significant correlation at the 0.01 level where \( r = 0.668 \). Functional integrity is also significantly negatively correlated to inconsistency at the 0.05 level where \( r = -0.543 \). Frequency of use and integrity are correlated with \( r = 0.517 \) and \( p < 0.05 \). The frequency of use is also correlated to confidence where \( r = 0.660 \) and \( p < 0.01 \). Another interesting feature is the correlation of cumbersome to use to technician's support (\( r = 0.689 \) and \( p < 0.01 \)) and to inconsistency (\( r = 0.470 \) and \( p < 0.05 \)). The complexity is significantly correlated to inconsistency (\( r = 0.812 \) and \( p < 0.01 \)), integrity (\( r = 0.490 \) and \( p < 0.05 \)), cumbersome to use (\( r = 0.484 \) and \( p < 0.05 \)) and technician's support (\( r = 0.546 \) and \( p < 0.05 \)).

In the administrative group, significant correlations are also demonstrated. Frequency of use is significantly correlated to confidence (\( r = 0.529 \) and \( p < 0.01 \)), as well as to need to learn before the use of the system (\( r = 0.483 \) and \( p < 0.01 \)) and integrity (\( r = 0.356 \) and \( p < 0.05 \)). Frequency of use is also significantly negatively correlated to complexity (\( r = -0.321 \) and \( p < 0.05 \)). Inconsistency and easy to use correlation is significant at the 0.01 level with \( r = 0.406 \). Inconsistency and technician's support correlation is also significant with \( r = 0.473 \) and \( p < 0.01 \). A significant negative correlation is demonstrated among cumbersome to use and integrity (\( r = -0.384 \) and \( p < 0.05 \)). Integrity is also significantly correlated to confidence (\( r = 0.469 \) and \( p < 0.01 \)). The negative correlations among complexity and confidence (\( r = -0.410 \) and \( p < 0.01 \)) and also among complexity and integrity (\( r = -0.371 \) and \( p < 0.05 \)) are significant. Complexity is also significantly correlated to cumbersome to use (\( r = 0.478 \) and \( p < 0.01 \)) and inconsistency (\( r = 0.330 \) and \( p < 0.05 \)). Finally, the integrity is negatively correlated to inconsistency (\( r = -0.304 \) and \( p < 0.05 \)) and cumbersome to use (\( r = -0.323 \) and \( p < 0.05 \)).
4. Discussion

4.1. General Considerations

Kavala’s Hospital information system is function-limited and is applied by a small percentage of health care professionals. At the administrative departments of the hospital, the system was applied by the majority of the employees. As a result, the percentage of the non-users administrative employees was high and the percentage of the non-users health care professionals was extremely high.

The percentage of the persons that denied participating in the study was very small. That probably happened due to the easiness of the SUS to be filled and its small size. By this way, the SUS firstly contributes to participant’s convenience and secondly reduces the risk of the small sample size caused by participants’ rejection to fill in the questionnaire. Consequently, the SUS proved a successful questionnaire for the evaluation of user satisfaction in hospitals, not only because of its flexibility, but also because of the wide range of aspects that covers.

The statistical evaluation of the data revealed that the majority of both administrative and health care users would like to use the system frequently. As far as for the perceived ease to use, the opinions of both health care professionals and administrative employees were fluctuated presenting however similarities among the two groups.

Health care users are seemed to believe that the system is easy to be learned and so, there is no need to get extra knowledge before its use. They also considered that the system is well integrated and consistent providing them confidence and desire for frequent use.

On the other hand, administrative users disagreed that the system is cumbersome and complex. In contrast, they are appeared to believe that it is well integrated, and consistent, providing them confidence for frequent use. It was also easy to learn it without requiring a lot of knowledge prior to use.

4.2. Correlations

The findings of this study for the health care group suggested that a well-integrated system makes confident users. Therefore they could handle it more frequently. The integrity affects significantly the inconsistency and vice versa.
The same bilateral relation is applied to inconsistency, which is significantly affected by complexity. When an information system is not well integrated then becomes inconsistent and complex and furthermore cumbersome for the user. Due to complexity, which results to a confusing for the user system, support from the technician becomes essential. Therefore, a correlation pathway among significant aspects, affecting the successful adoption of the system may be hypothesised as far as for user satisfaction consideration, in which all the above are represented.

In the administrative group, interesting interrelations are also demonstrated. A well-integrated information system makes its user confident to handle the system frequently. But a non well-integrated system makes the user impatient and unwilling to use it regularly. The complex system is cumbersome to use. A well-integrated information system is also consistent and less complex. Thus, according to the findings of the study the negative and bilateral relationship among complexity and integrity is very strong. A complex system is not an integrated system and vice versa. So, a complex system creates a field of insecurity to the users and therefore becomes cumbersome and inconsistent for them. The inconsistent system emphasises the need for support from a technician as vital. All the above are demonstrated at the following scheme.
User satisfaction depends on the way that the system facilitates the user (Dupuits and Hasman, 1995). For the successful adoption of the system and therefore for user satisfaction it is also necessary, the system to be integrated. By this way the users would be confident to use the system frequently. A non-well integrated system is complex and inconsistent. The triangles among Confidence- Integrity- Frequency to use (CIF triangle) and Integrity- Complexity- Inconsistency (ICI triangle) found to have significant value in both groups. Therefore, there is a strong indication for their adoption in evaluation studies.

4.3. Conclusion
The development of information system technology in a hospital environment is in early stages and still under consideration by the local authorities. And even this milestone is overcome, a great emphasis should be given in the level of training of all health-related and administrative professionals. The fact that most of the health professionals are not users of
this technology creates a field of confusion affecting mainly the persons seeking medical health care. For the successful adoption of an innovative HIS, evaluation studies should include tests for user satisfaction. The CIF and ICI triangles could be important concepts that should be used for the assessment of user satisfaction and therefore of hospital information systems. Further research utilising a larger selection of both health-related professionals and administrative employees would be recommended for future trials. The SUS questionnaire used in this study was proved very useful for this purpose. However, the need for a more holistic approach in terms of the hospital information systems sphere of evaluation is required.
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