

## ***Developing a Prototype of Mobile Dental Information System in Indonesia***

**Leo Willyanto Santoso, Alexander Setiawan, Samuel Gunawan**

Fakultas Teknologi Industri, Jurusan Teknik Informatika, Universitas Kristen Petra

Jl. Siwalankerto 121 – 131, Surabaya 60236, Indonesia

E-mail: leow@petra.ac.id

**Abstract.** *With the rapid development of wireless technology, mobile devices applications and services have become more convenient. One area that can be supported by this technology is the field of health, particularly in the dental information system. Processing the patient data is one of the many factors that have an important role in hospital industry. The manual processing of patient data in dental clinic 'X' Yogyakarta, Indonesia is inefficient and ineffective. It can't guarantee the accuracy of the calculation, recapitulations, and reporting system. The rapid development of information technology makes it possible to develop a dental information system, which gives accurate reports on the status of the patients in real time for the purpose of improving patient's safety and quality of services. In this research, the application is developed with Java programming language and MySQL database. The testing results of the application have shown that the program can be operated easily, has a clear work flow, supports various facilities that help users, and is able to become valuable inputs for dental clinic management in the decision making process. Based on the questionnaire results, 80% respondents reported that the program met the requirements and was easy to use.*

**Keywords:** *mobile technology, dental information system, registration, report*

### **Abstrak.**

Perkembangan teknologi nirkabel yang sangat pesat telah memicu aplikasi dan layanan seluler menjadi lebih nyaman. Salah satu bidang yang dapat didukung oleh teknologi ini adalah bidang kesehatan, terutama dalam sistem informasi klinik gigi. Pengolahan data pasien merupakan salah satu faktor yang memiliki peran penting dalam pengelolaan industri kesehatan. Saat ini, proses manual pengolahan data pasien di klinik gigi 'x' Yogyakarta tidak efisien dan tidak efektif. Hal ini tidak dapat menjamin keakuratan perhitungan, rekapitulasi, dan sistem pelaporan. Pesatnya perkembangan teknologi informasi memungkinkan untuk mengembangkan sistem informasi gigi, yang memberikan laporan yang akurat tentang status pasien secara real time untuk tujuan meningkatkan keselamatan pasien dan mutu layanan. Dalam penelitian ini, aplikasi dikembangkan dengan bahasa pemrograman *Java* dan *database MySQL*. Hasil pengujian aplikasi telah menunjukkan bahwa program ini dapat dioperasikan dengan mudah, memiliki alur kerja yang jelas, mendukung berbagai fasilitas yang membantu pengguna, dan mampu menjadi masukan yang berharga untuk manajemen klinik gigi untuk membuat keputusan. Berdasarkan hasil *survey*, 80% responden berkata bahwa program sudah memenuhi kebutuhan dan mudah untuk digunakan.

**Kata kunci:** teknologi bergerak, sistem informasi dokter gigi, registrasi, laporan

### **1. Introduction**

Dental Information System (DIS) is a union of different activities covering the whole range of dental clinic efforts to produce, utilize and make use of dental information to support the activities of the clinic.

Viewed from a system approach, DIS consists of three components, namely input, process and output. Input component consists of required information or data to support the efforts of dental clinic and management, recording and reporting instruments as well as resources for processing and utilization of data and information (Berg, 2001). Process component consists of organizing, managing and processing of data and clinic information. Component output includes the storage, distribution and utilization of data and information (Wilson, 2006).

One very important factor for the stabilization and development of DIS is a component of the input system, namely recording and reporting instruments. Based on the decision of the Indonesia Minister of Health No. 651/XI-AU/PK/72, recording and reporting are standardized to Recording and Reporting of Hospitality System (Sistem Pencatatan dan Pelaporan Rumah Sakit/SP2RS). SP2RS is coordinated and managed by the Directorate General of Medical Services. The system is then updated in 1984 with the publication of Health Minister's decision No. 691A/Menkes/SK/XII/1984 (Ministry of Health Republic of Indonesia, 1992; 1993a).

Recording and reporting activities in clinics are generally carried out by the unit medical record (Ministry of Health Republic of Indonesia, 1993b). This unit is tasked with collecting data on an individual patient, either in the form of medical records, social background and record of all things related to her illness. The data is then processed and analyzed so as to produce a useful information for the person of the patient, the health providers in this regard is the clinic where patients were treated, as well as for others who need it (Wager, Lee, & Glaser, 2009). For clinics, one of the medical records purpose is the availability of reporting data as a clinic to the Department of Health (Ministry of Health Republic of Indonesia, 1997).

Data processing of medical records of patients in a hospital includes two things, namely: data outpatient and inpatient data (Weir, Staggers, & Laukert, 2012). Patient data processing is still done manually, so much has weaknesses. These weaknesses include: 1) Ineffective processing. The process of counting and the recapitulation of the data manual cannot guarantee the accuracy of the information generated. In addition, daily data collection, especially in hospitalized patients are often not on time, resulting in delays in the counting process and the recapitulation of the data, which eventually resulted in a report to the Ministry of Health cannot be completed on time. 2) Inefficient processing. Recapitulated patient data each day to count and verify the data. In addition, each month also made a recapitulation of daily data already entered. Monthly recap this process requires a long time and done not only by a single person unit medical records clerk. This indicates that the process is less efficient in terms of time, effort and cost. 3) Limitations of the amount of information can be obtained from the patient data processing. The lack of time and personnel capabilities of data processing records, causing a lack of development of information can be obtained from the patient data. 4) Limited access important information by time. By developing a computerized system based on client-server architecture, any information changes directly record in a centralized computer server. This information can then be flexibly accessed from anywhere and at any time, so the acquisition and change information is not limited by place and time.

By integrating DIS with mobile devices technology, so when a dentist or nurse checks the patient, then all the records they make, like the current situation and the patient's treatment can be recorded directly to the database server, so no data entry required by manual. Thus, the accuracy of the information can be maintained.

This paper presents the integration between DIS and mobile device application to support day to day activity in clinical industry. This developed application have had considered backup and disaster recovery technology.

The remaining part of this paper is organized as follows. Section 2 presents an overview of current proposal for dealing with medical record and mobile dental information system. Section 3 presents the methodology of this research and the approach that we have delineated to solve the proposed problems. Section 4 discusses the performance of proposed methods. Finally, section 5 concludes the paper.

## 2. Literature Review

### 2.1. Medical Record

Medical record information is defined as either a written or recorded on the identity, physical determination of laboratory, diagnostic services and all medical measures given to patients, and treatment for both inpatients and outpatients (Ministry of Health Republic of Indonesia, 1993b).

Based on the process and recorded material, medical records through various changes in form, ranging from the Hippocratic era to the era of medicine with the latest medical today. Evolution of medical records can be explained into four periods, namely: 1) Oriented medical record at the time. 2) Medical record patient-centered. 3) Oriented medical record problem. 4) Oriented medical record sources.

Meanwhile, according to records, medical records are divided into two parts, namely: 1) Paper-based medical record. 2) Computer-based medical record.

The purpose of medical records is to support the achievement of orderly administration in the context of efforts to improve health services in hospitals (Andersen & Jansen, 2011). Usefulness of medical records can be viewed from several aspects including (Ministry of Health Republic of Indonesia, 1992; 1997; Trimmer et al, 2009): 1) Aspects of the administration, because it concerns actions by the authority and responsibilities as the medical and paramedical personnel in achieving health goals. 2) Medical aspects, because the record is used as a basis for planning treatment/care to be given to a patient. 3) Legal aspects, because it guarantees a matter of legal certainty on the basis of justice, in order to attempting enforce the law and providing material evidence to uphold justice (Lohr, Sadeghi, & Winandy, 2010). 4) Financial aspect, because it can be used as material to determine the cost of payment services in the hospital. 5) Aspects of research, because it contains data/information that can be used as an aspect of research and development of science in the field of health. 6) Aspects of education, because it concerns the data/information about the chronological development of the activities of medical services provided to patients. This information can be used as a material/reference in the field of teaching profession. 7) Aspects of documentation, because it becomes a source of memories that must be documented and used as an ingredient of accountability and hospital reports.

In general, the use of medical records is (Ministry of Health Republic of Indonesia, 1993b): 1) As a means of communication between doctors with their expert personnel who took part in providing services, treatment, care for the patient. 2) As a basis for planning of treatment/care to be given to a patient. 3) In written evidence of any act of service, the development of disease, and treatment for a patient visit / hospitalization. 4) As a useful material for analysis, research, and evaluation of the quality of services provided to patients. 5) Protect the legal interests of patients, hospitals and physicians and other health personnel. 6) Provide specific data that are useful for research and educational purposes. 7) As a basis in the calculation of the cost of patient medical service payments. 8) A source memory should be documented, as well as accountability and reporting materials.

Based on the above objectives and benefits, the medical records have a very important role in the hospitality industry. Computerized medical records should be done to support services in hospitals.

### 2.2. Mobile Dental Information System

Mobile Dental Information System (MDIS) is a dental information system supported by mobile devices, such as mobile phones, patient monitoring devices, PDAs, and other wireless devices. MHIS applications include the use of mobile devices in collecting community and clinical health data, delivery of healthcare information to practitioners, researchers, and patients, real-time monitoring of patient vital signs, and direct provision of care (Germanakos, Mourlas, & Samaras, 2005).

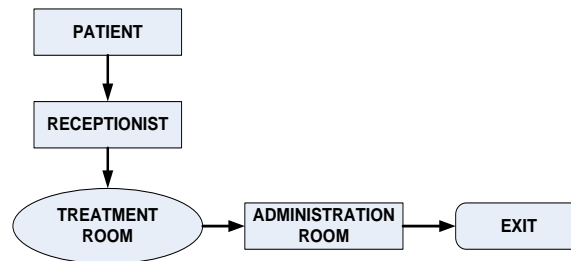
Efforts are ongoing to explore how MDIS technologies can improve health outcomes as well as generate cost savings within the clinics systems of middle and low income countries (Taylor & Leitman, 2001). The advantage of MDIS is the opportunities for direct voice

communication (of particular value due to literacy and language capacity in many countries) and information transfer capabilities that previous technologies did not. This is particularly beneficial for work in remote areas where the mobile phone, and now increasingly wireless infrastructure, is able to reach more people.

Some of the MDIS strategic objectives are: 1) Improvement of the access to emergency and general health services. 2) Improvement of the efficiency of health service delivery. 3) Improvement of the clinical practice for enhanced health outcomes.

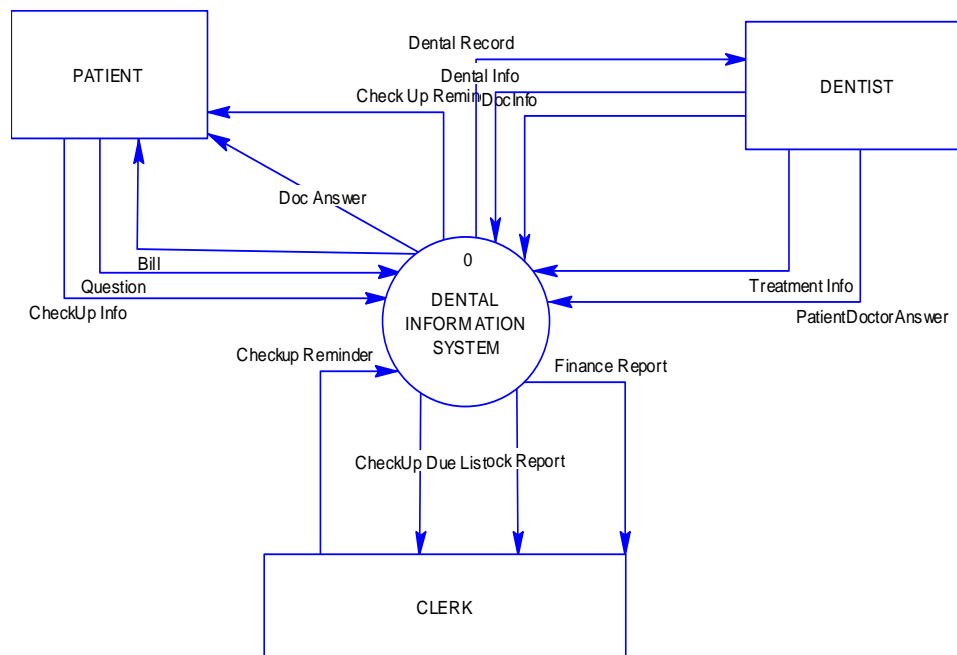
### 3. Methodology

In general, a process that took place in dental clinic can be described in diagrammatic form as in Figure 1.



**Figure 1. Hospital Flow Process**

Developing this software, we are taking steps as follows: 1) The study of literature and understanding of the system (O'Brien & Marakas, 2010). This literature study is done by collecting and studying the literature related to the data processing of hospital patient. Besides supporting data obtained from literature books, also obtained by looking for supporting data from the hospital. 2) Analyzing and Designing software (Senn, 1989; Kendall & Kendall, 2010). Based on the literature study was done, the next step is to design flowcharts, algorithms, data structures and review of the use of technologies associated with hospitality software. 3) Developing software. At this stage it is the implementation of the design program at the previous step. 4) Evaluation software. At this stage of the evaluation process of the software was conducted.



**Figure 2. Context Diagram for DIS**

The design software is done by creating Data Flow Diagram (DFD) of the system that has been observed. In Figure 2 can be seen from the system context diagram in dental clinic. The system interacts with three external entities, namely Patient, Dentist and Clerk. These three external entities interact with DIS directly. Patients which are represented by the entity PATIENT, will provide personal, medical and dental information to the system. Appointment and questions will also be provided as inputs by patients to the system. The system will generate bills, doctors' answer, dental record and checkup reminder to the patient. DENTIST entity will receive dental record, patient info and formatted question as input from the system and it will send doctor answer, dental info, and treatment info to the system. CLERK receives stock list and finance report as output from the system, and send checkup reminder as input for the system.

After doing the design and normalization of data, derived tables and the necessary attributes, namely: 1) Patient (PIId, PFirstName, PLastName, PDOB, POccupation, PReligion, PAddress, PCity, PState, PZip, PPhone, PMobile, PStatus, PNote) 2) PatientMedicalRecord (PIId, T11, T12, T13, T14, T15, T16, T17, T18, T21, T22, T23, T24, T25, T26, T27, T28, T31, T32, T33, T34, T35, T36, T37, T38, T41, T42, T43, T44, T45, T46, T47, T48). 3) Dentist (DIId, DFirstName, DLastName, DSex, DDOB, DReligion, DAddress, DCity, DState, DZip, DPhone, DMobile, DHiredate, DNote). 4) Password (USerId, USerName, Password). 5) Calendar (DOcName, CAlDate, CAlTime, CalStatus, Pid). 6) MonthlyRevenue (Year, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec). 7) DaylyRevenue (Year, MOnth, Day1, Day2, Day3, Day4, Day5, Day6, Day7, Day8, Day9, Day10, Day11, Day12, Day13, Day14, Day15, Day16, Day17, Day18, Day19, Day20, Day21, Day22, Day23, Day24, Day25, Day26, Day27, Day28, Day29, Day30, Day31). 8) PatQuestion (PIId, QuesDate, PatQ, AnsDate). 9) Staff (SIId, SFirstName, SLastName, SDOB, SAddress, SMobile). 10) Stock (STockId, StockName, Num, StockDate). 11) Supplier (SUppId, SuppName, SuppAddress, SuppCity, SuppState, SuppZip, SuppPhone, SuppMobile, SuppEmail). 12) Treatment (TReatId, PIId, TreatDoc, TreatDt, TreatTotal). 13) TreatDetail (TReatId, ItemNo, TreatDesc, Charges).

MDIS technologies and organizational specification are determined. Selection and acquisition of hardware and software is done at this stage.

#### 4. Result and Discussion

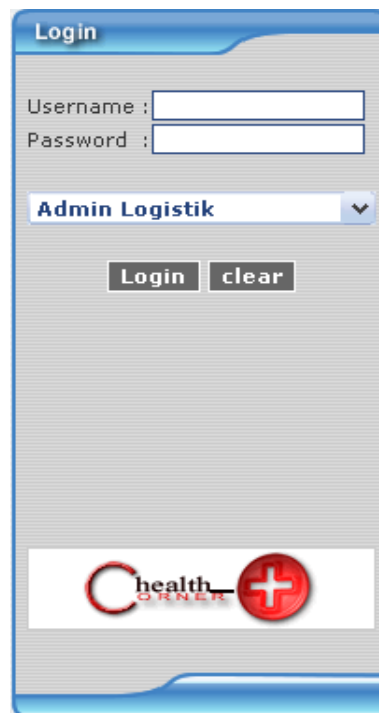
This part described in detail the testing process for the application that has been implemented. Tests performed on each menu as a whole, with the aim to be seen whether the program runs well. In this section, we present experimental result of the mobile dental information system. This system was built in Java on a PC with 2.4 GHz Pentium ® 4 CPU and 1 GB of RAM under MS Windows Server 2003.

Mobile dental information system covers the registration, outpatient transactions services, inpatient transactions services, payments and recapitulation of the clinic reports. The report of these activities can be generated automatically with this application.

Testing software is formulated based on the functional needs of mobile dental information system. Login form must be entry with correct username and password before using all features in this application. Interface of login form can be seen in Figure 3.

In subsystem registration and registration of patients, include the following functions: 1) The system can support the process of recording a clinic patient registration. Interface of the program can be seen in Figure 4. 2) The system can automate medical record number and the registration number of patients. 3) The system can process the results of patients who had been treated in clinic based on medical record number or the name of the patient. This is used by medical personnel to see the history of the disease and treatment process. Interface of the program can be seen in Figure 5. 4) The system can display the registration of all patients.

After the registration process are complete, patients undergoing the process of clinical services.



The login form is titled "Login" and features a blue header. It contains two input fields for "Username" and "Password". Below these is a dropdown menu currently set to "Admin Logistik". At the bottom of the form are two buttons: "Login" and "clear". A logo for "health ORIENT" with a red cross icon is positioned at the very bottom.

Figure 3. Login Form



The "Pendaftaran Layanan Medis Pasien" (Patient Medical Service Registration) form is divided into two main sections. The top section, "Pendaftaran Penunjang Medis" (Medical Support Registration), includes fields for "Tanggal / Date" (07/14/2009, 14 Jul 2009), "Pelayanan" (RADIOLOGI), and "Dokter" (-). The bottom section, "Data Pasien" (Patient Data), contains fields for "No. Reg" (0000197135), "Nama / Name" (JOLANDA KATUUK NY), "Jenis Kelamin / Sex" (Perempuan), "Alamat / Address" (JOHAR I/5 REDWIN WEDORO WARU SDA), "Pukul / Time (hh:mm)" (21 : 26), and "Tanggal Daftar" (14 Jul 2009, 21:30). A "Keterangan" (Remarks) text area is at the bottom. "Simpan" (Save) and "Batal" (Cancel) buttons are located between the two sections.

Figure 4. Interface of Patient Master Form

**Tambah Tindakan Rawat Jalan**

NAMA TINDAKAN  Simpan Batal

HARGA TINDAKAN

ASAL TINDAKAN

**Tambah Tindakan Rawat Jalan**

NAMA MATKES  Simpan Batal

HARGA MATKES

ASAL MATKES

**Tambah Periksa Laboratorium**

NAMA PERIKSA LAB  Simpan Batal

HARGA BASA

HARGA CITO

ASAL PERIKSA LAB

BAGIAN PERIKSA LAB

**Tindakan per Pasien**

Pasien Aktif		Pasien Mati	
Tanggal	14-07-2009 / 08:53	Tanggal RM	01-07-2009
No RM	0000700001	Tanggal Lahir	01-01-1980
Nama Pasien	ACHMAD PRAMUDITO TN	Jenis	100 tahun
Alamat Pasien	PURI INDAH ASRI CE NO 14 SIDOARJO	Jenis Pasien	Tanggal RM
Alamat Pasien		Dokter Periksa	STANISLAV, Dr. Sp. H
Alamat Pasien			

**Periksa Lab**

No	Pemeriksaan	Tgl Pemeriksaan	Jumlah	Harga Pemeriksaan (Rp.)

Figure 5. Interface of Treatment Form

Patient payment system includes a function that the system can display the report based on the patient's payment for all the transactions that have been conducted of patients during treatment. Interface of the program can be seen in Figure 6, Figure 7 and Figure 8.

**Pengisian Cicilan Pasien**

**Data Pasien**

ID Pasien 0000309304

Nama Pasien ACHMAD PRAMUDITO TN

Alamat Pasien PURI INDAH ASRI CE NO 14 SIDOARJO

**Data Cicilan**

Jumlah Cicilan sampai Saat Ini Rp. 0.00 [detail](#)

Jumlah Uang Tunai 0

Keterangan Cicilan

Simpan Batal

Figure 6. Installment Patient Form

**Pengisian Deposit Pasien**

**Data Pasien**

ID Pasien	0000326296
Nama Pasien	A.M AKBAR DJALALI, IR TN
Alamat Pasien	RUNGKUT BARATA VII NO 30 SURABAYA

**Data Cicilan**

Jumlah Cicilan sampai Saat Ini	Rp. 200,000.00 <a href="#">detail</a>
Jumlah Uang Tunai	0
Keterangan Cicilan	

Simpan Batal

Figure 7. Deposit Patient Form

Nomor Pasien : P090700001

**PASIEH**

ID Pasien	P090700001
Ras Nama	werwrwe
Nama Pasien	werwrwe
Perusahaan Penjamin	tidak ada

**Term**

Term Pembayaran: Kas Masuk Tunai

**Pembayaran**

Pembayaran Tunai 0 Bayar

**Diskon**

Diskon 0

**Status**

☒ Telah diCek ☐ Belum diCek

**TOTAL TAGIHAN** 0.00

Simpan Kembali

Figure 8. Interface of Payment Form

Recapitulation of the patient's system includes the following functions: 1) The system can display the daily recap of patients include: patients entered, the patient out, moving patients, and the patient died. View of the report can be seen in Figure 9. 2) The system can see the data that contain clinic activity within the quarter. Interface of the program can be seen in Figure 10.



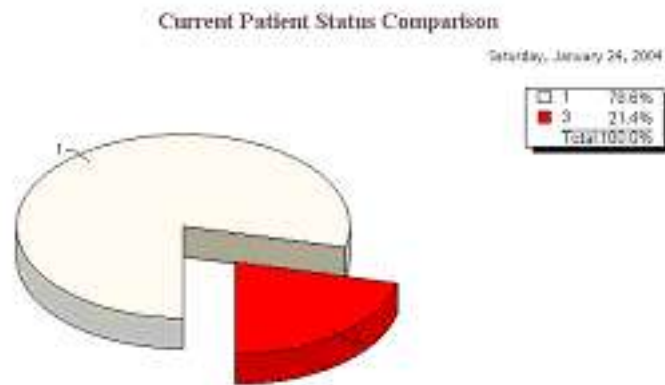


Figure 9. Patient Recapitulation Report

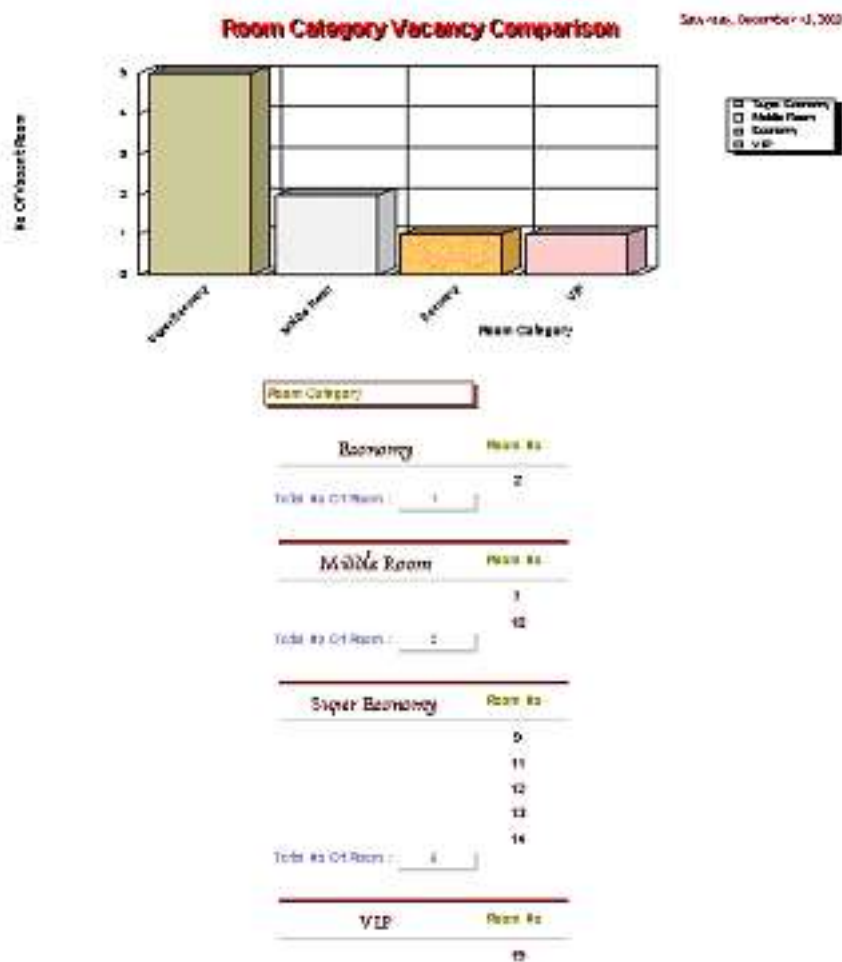


Figure 10. Room Usage Report

## 5. Conclusions

This paper deals with the implementation of mobile dental information system. Conclusions obtained from this research are as follows: 1) Mobile dental information system is the best alternative in terms of efficiency and effectiveness, because it can handle the growing workload increases with the hospital development of rapid and dynamic. 2) Mobile dental information system can provide other information that is more diverse with a more

communicative and informative. We are currently working on the evaluation of the performance and integrating with RFID technology.

## References

- Andersen, S.T. & Jansen, A. 2011. Innovation in ICT-Based Health Care Provision. *International Journal of Healthcare Information Systems and Informatics*. Vol 6(2): 14-27.
- Berg, M. 2001. Implementing Information System in Healthcare Organization: Myths and Challenges. *International Journal of Medical Informatics*. Vol 64(2): 143-156.
- Germanakos, P., Mourlas, C., & Samaras, G. 2005. *A Mobile Agent Approach for Ubiquitous and Personalized aHealth Information Systems*. Proceedings of the Workshop on Personalization for eHealth of the 10<sup>th</sup> International Conference on User Modelling (UM'05). Edinburgh, July 29, 2005, pp. 67-70.
- Kendall, K.E. & Kendall, J.E. 2010. *System Analysis and Design* (8<sup>th</sup> Ed.). Singapore: Prentice Hall.
- Lohr, H., Sadeghi, A.R., Winandy, M. 2010. *Securing the E-Health Cloud*. Proceedings of the 1<sup>st</sup> ACM International Health Informatics Symposium (IHI'10). Arlington, November 11-12, 2010, pp. 220.
- Ministry of Health Republic of Indonesia. 1992. *Hospital Service Standard*, Jakarta: Directorate General of Hospital and Education, 1992.
- Ministry of Health Republic of Indonesia. 1993. *Principles of Consolidation and Development of Health Information System*, Jakarta: Health Data Center, 1993a.
- Ministry of Health Republic of Indonesia. 1993. *Technical Guidelines for Implementation of Medical Record in Hospital*, Jakarta: Directorate General of Medical Services, 1993b.
- Ministry of Health Republic of Indonesia. 1997. *Guidelines for Hospital Information systems (Hospital Reporting System IV in Indonesia)*. Jakarta: Directorate General of Medical Services: 1-25, 1997.
- O'Brien, J. & Marakas, G. 2010. *Management Information System* (10<sup>th</sup> Ed.). Singapore: McGraw-Hill Book Company.
- Senn, J.A. 1989. *Analysis and Design of Information Systems* (2<sup>nd</sup> Ed.). Singapore: McGraw-Hill Book Company.
- Taylor, H. & Leitman, R. (Eds). 2001. *Health Care News*, Harris Interactive, Rochester.
- Trimmer, K., Celluci, L.W., Wiggins, C., Woodhouse, W. 2009. Electronic Medical Records: TAM, UTAUT and Culture. *International Journal of Healthcare Information Systems and Informatics*. Vol 4(3): 55-68.
- Wager, K.A., Lee, F.W., & Glaser, J.P. 2009. *Health Care Information Systems: A Practical Approach for Health Care Management* (2<sup>nd</sup> Ed.). New York: Jossey-Bass Pub.
- Weir, C.R., Staggers, N., Laukert, T. 2012. Reviewing the Impact of Computerized Provider Order Entry on Clinical Outcomes: The Quality of Systematic Reviews. *International Journal of Medical Informatics*. Vol 81(4): 219-231.
- Wilson, E.V. 2006. Building Better E-Health Through a Personal Health Informatics Pedagogy. *International Journal of Healthcare Information Systems and Informatics*. Vol 1(3): 69-76.