



Accuracy Implementation of Medical Record Management Information System with Waterfall Design System and ISO 9126

Wahyu Wijaya Widiyanto^{1*} and Sri Wulandari¹

¹Politeknik Indonusa Surakarta, JL. KH. Samanhudi No. 31, Mangkuyudan, Surakarta, Central Java, Indonesia.

Authors' contributions

This work is carried out in collaboration between both authors. Author WWW designed the study, performed statistical analysis, wrote the protocol and wrote the first draft of the text then administered the research analysis. Author SW managed the literature search. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRCOS/2020/v6i230156

Editor(s):

- (1) Dr. Young Lee, Texas A&M University–Kingsville (TAMUK), USA.
- (2) Dr. G. Sudheer, GVP College of Engineering for Women, India.
- (3) M. A. Jayaram, Siddaganga institute of Technology, India.

Reviewers:

- (1) Rinku Kalra, Maharashtra University of Health Sciences, India.
- (2) Mohammed Hasen Badeso, Jimma University, Ethiopia.
- (3) Deepika Hugar, Central University of Karnataka, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/60968>

Original Research Article

Received 02 July 2020
Accepted 07 September 2020
Published 21 September 2020

ABSTRACT

Aims: Based on the observations of researchers, some health facilities still use manual processes / have not been documented by the information system resulting in slow service, this study aims to improve health services with a medical record information system.

Methodology: The method used in this study is an analysis of information systems with the waterfall method and accuracy testing with ISO 9126.

Results: The results of this medical record management information system run well based on black-box testing and white box results obtained both from an average value of 82 based on the ISO 9126 scale conversion table.

Conclusion: Based on the results of the average value obtained from the validation test carried out on 3 expert examiners, it can be concluded that the application for the validation system for the validation and distribution of this letter has met the ISO 9126 standard with an average good

*Corresponding author: E-mail: wahyuwijaya@poltekindonusa.ac.id;

interpretation of a total value of 82, and according to be able to simplify the process of Patient Medical Record Data Management without neglecting the safety aspects of the validation and distribution process, minimizing data loss, simplifying the reporting process and facilitating the processing of patient medical record data.

Keywords: Accuracy; health facilities; ISO 9126; medical records; waterfall model.

1. INTRODUCTION

Medical records are very important in the health facility management system (hospitals, health centers, clinics). In addition to recording patient visits, medical records can also be used to track a patient's medical history. Medical records are facts provided with the patient's condition, medical history, and past and current medications written by a health professional providing services to that patient [1]. The system is any unit, conceptually, or physically consisting of parts in a state of mutual dependence on each other [2]. The information has many definitions, one of which is that information is data that has been processed into a meaningful form for those who receive it and is useful in making future decisions. One solution is a management information system. Management Information Systems can determine the operation of a company or an organization that supports the information contained in it for decision making [3].

The implementation of the medical record data collection system starts when the patient is admitted to the health facility with all forms of action given by the patient. This implementation aims to support the achievement of administrative order as an effort to improve health services, without the support of a good and correct medical record management system, administrative order will be difficult to materialize [4].

Management of medical records that are not carried out according to procedures and guidelines can result in the loss of information on medical record records. Problems like this can occur in health care facilities (health service facilities) that do not run a medical record management system properly, lack of special attention to medical records, lack of human resources and medical record management units that carry out various jobs so that they do not focus on handling records management medical [5].

2. MATERIALS AND METHODS

2.1 Waterfall Model

According to Pressman, the waterfall model is a classic model that is systematic, sequential in building software [6]. The name of this model is actually "The Linear Sequential Model". This model is often referred to as the "classic life cycle" or the waterfall method. This model is included in the generic model in software engineering and was first introduced by Winston Royce around 1970 so that it is often considered outdated, but is the most widely used model in Software Engineering (SE). This model takes a systematic and sequential approach. It is called the waterfall because the steps that are passed must wait for the completion of the previous stage and run sequentially [7–11].

The five main stages of the waterfall model are shown in Fig. 1, i.e.:

2.1.1 Requirements definition

The system's services, constraints, and objectives are built by consultation with system users. They serve as a system specification.

2.1.2 System and software design

The process of systems design allocates the requirements to either hardware or software systems by building a system architecture.

2.1.3 Implementation and unit testing

During this part, the software design is realized as a set of programs or program units. Unit testing's purpose is to verify that every unit meets the specification.

2.1.4 Integration and system testing

The program units are integrated and tested as an accomplished system to assure that it is fitted with the software requirements. After system testing has been done, the software system is delivered to the client.

2.1.5 Operation and maintenance

This is the final stage in the waterfall model. The finished software is run and maintenance is done. Maintenance includes fixing errors that were not found in the previous step. Improved implementation of system units and increased system services as new requirements.

development and after entering the operation process.

This study analyzes the implementation of medical record management based on information systems developed by the waterfall development model and system accuracy testing using ISO 9126 focusing on software. At this stage, researchers read references related to the International Organization for Standardization (ISO) 9126 software quality measurement model that will be used in system testing [12-15].

2.2 ISO 9126

ISO 9126 defines quality as a set of features and characteristics of a product or service. It provides external quality metrics for measuring software quality characteristics applicable to an executable software product during testing or operating at a later stage of

The system is installed and used by the client. Maintenance includes correcting errors which were found after using the system, improving the system with the new requirements

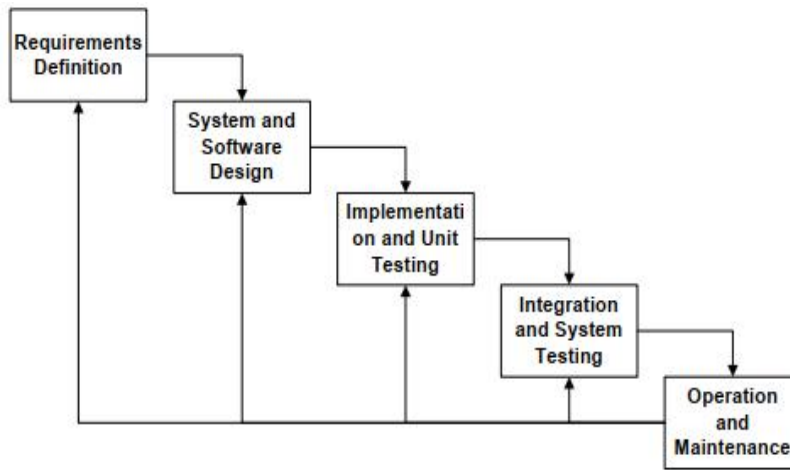


Fig. 1. The waterfall model

Table 1. Characteristics of the ISO 9126-1 quality model

Characteristic	Description
Functionality	The capability of the software to provide functions which meet the stated and implied needs of users under specified conditions of usage (what the software does to meet needs)
Reliability	The capability of the software product to maintain its level of performance under stated conditions for a stated period time
Usability	The capability of the software product to be understood, learned, used and provide visual appeal, under specified conditions of usage (the effort needed for use)
Efficiency	The capability of the software product to provide desired performance, relative to the number of resources used, under stated conditions
Maintainability	The capability of the software product to be modified which may include corrections, improvements or adaptations of the software to changes in the environment and the requirements and functional specifications (the effort needed for modification)
Portability	The capability of the software product to be 'transferred from one environment to another. The environment may include organizational, hardware or software'

3. RESULTS AND DISCUSSION

The research method that the authors do is to develop a patient medical record management information system program with the waterfall development model method and to test the accuracy of the system formed based on the ISO 9126 reference regarding software. For more details, the research flow is shown in Fig. 2.

Based on Fig. 2 above, the research flow carried out is:

- i) Determining the background of the problem, this stage is the initial stage in research where the background of the problem can help in determining the goals and targets that must be achieved from the research carried out. This research was started from a literature study after finding the problems that were found to strengthen the research.
- ii) After getting several references as a literature study, then collecting data for application in research, this data collection is divided into primary data collection and secondary data.
- iii) From the data collected, then design/development of a patient medical record management system using the waterfall method,

- iv) Implementation of the program is the stage of submitting the results of the program to be tested.
- v) Testing is the last step in this flow, testing/testing is carried out by experts, the experts in question are the users themselves consisting of doctors, IT personnel, and administrators

Based on observations of patient data management in XYZ health facilities, until now, it is still using manual methods both in recapitulating patient data, as well as making the necessary reports. From the results of research conducted, the researchers obtained the following results:

- i) The process of managing patient data still uses a ledger, where the recording still uses the ballpoint media.
- ii) The process of making reports is still manual, namely by writing patient data. This process takes a very long time and the results of the writing are inaccurate because there is the possibility of errors in the processing.

From these problems, it can be concluded that the main cause of problems that occurred in XYZ health facilities in managing patient data is still using the old system, namely the ledger. The flow is illustrated in Fig. 3.

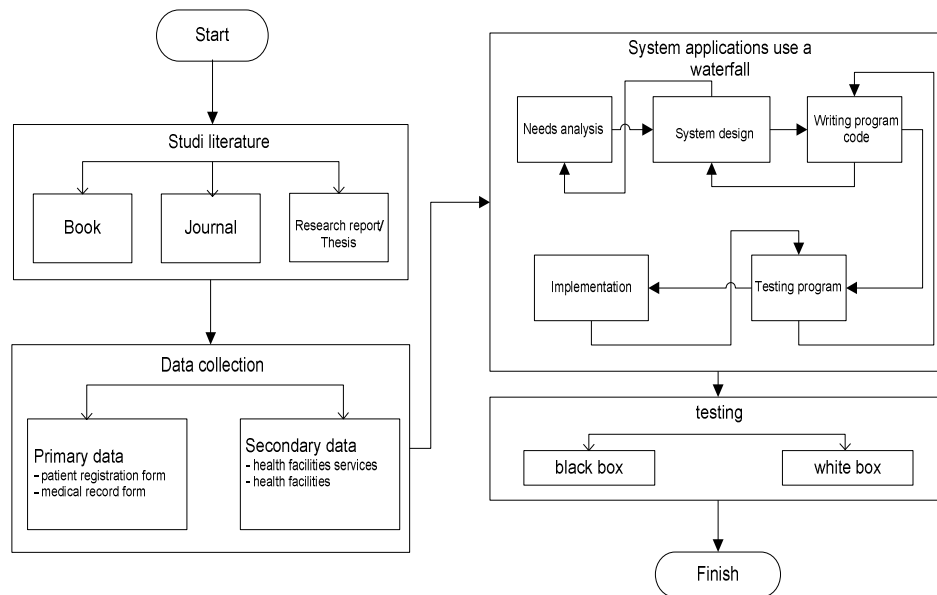


Fig. 2. Research flow

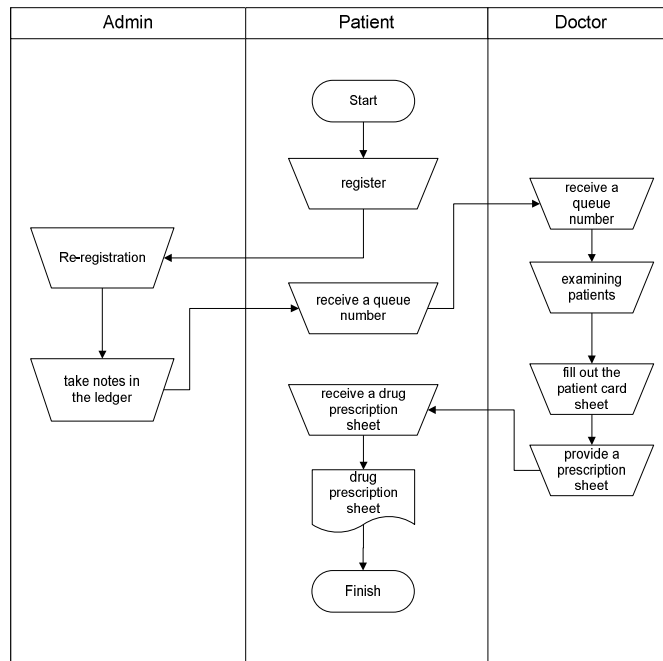


Fig. 3. Manual patient data management

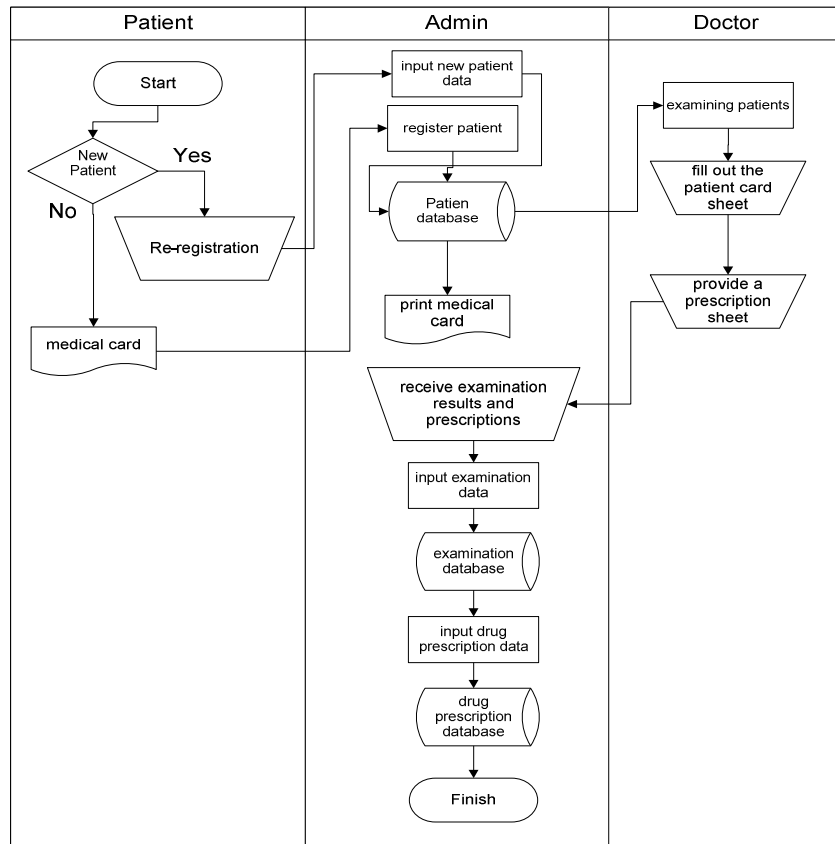


Fig. 4. Flowchart system developed

After getting an overview of patient data management manually, the researcher then develops a system with a reference to the new system that must have a good, correct, and clear system design. The procedures in the system being developed are almost the same as the ongoing system, the difference is that most of the data collection activities are carried out by the system so that it is faster, especially in the report

generation section, all handled by the system, Fig. 4 is a system flowchart developed:

The implementation of the figure above is then made a system context diagram in Fig. 5. The context diagram is a diagram that describes an outline of the information system with the entities involved in the system. In the context diagram also describes the flow of data into and out

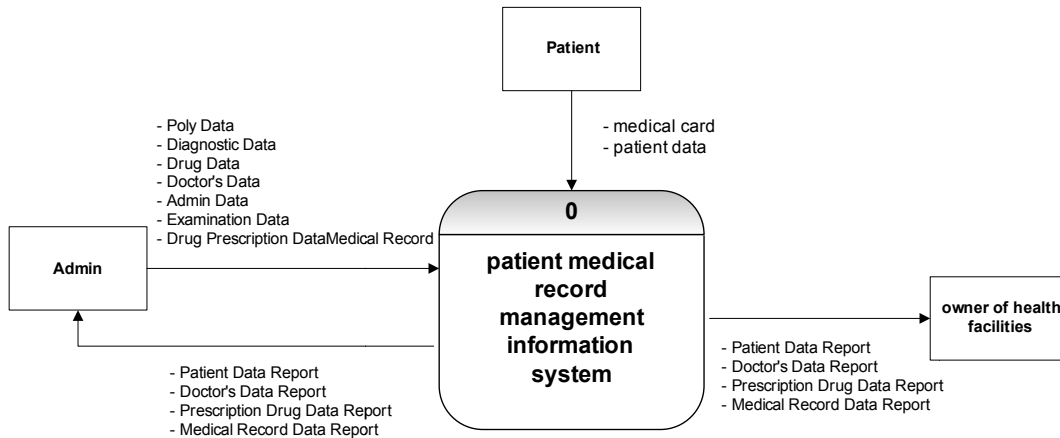


Fig. 5. Context diagram

4. CONCLUSION

The implementation of the Medical Record Management Information System is shown in Figs. 6, 7, 8, 9, 10 and 11.

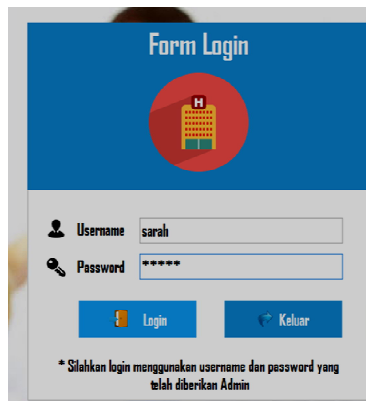


Fig. 6. Login form

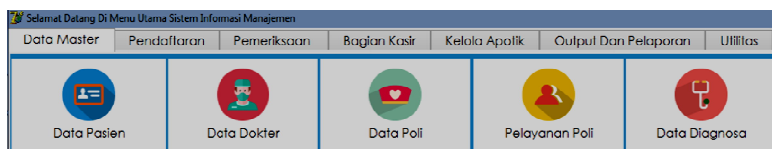


Fig. 7. System menu

Input Data Pasien

No. Registrasi:

Tgl. Registrasi:

Jenis Pendaftaran:

No. KK:

Nama KK:

No. BPJS:

Nama BPJS:

Nama Pasien:

Status:

Pekerjaan:

Alamat:

No. Telp:

Tanggal Lahir:

Tgl. Lahir:

Umur:

Jenis Kelamin:

Caril Berdasarkan:

Kata Pencarian:

No. Registrasi	Pendaftaran	Tgl. Reg.	No. KK	Nama KK
A-0001	BPJS Kesehatan	05/08/2014	30000000000-00	AJ Satriawan
A-0001-1	BPJS Kesehatan	05/08/2014	30000000000-00	AJ Satriawan
A-0001-2	BPJS Kesehatan	05/08/2014	30000000000-00	AJ Satriawan
B-0001	BPJS Ketenagakerjaan	05/08/2014	090-020-200-10290	Ari Wibisono
U-0001	UMUM	05/08/2014	214002000000000	Antonio Hamdi

Buttons: + Tambah (Input), Simpan, Batal, Hapus, Tambahkan Data Anggota Input, Cetak Kartu Berobat

Fig. 8. Patient data entry form

Data Pemeriksaan

No. Pemeriksaan:

Tgl. Periksa:

No. Pendaftaran:

No. Registrasi:

Nama Pasien:

Umur:

Jenis Kunjungan:

Kunjungan:

Keluhan:

Pemeriksaan Fisik:

Rujuk Lanjut:

Buttons: Diagnosa, Tindakan, Resep, Rekam Medis, Cetak Pemeriksaan

Buttons: Pemeriksaan Selesai, Pemeriksaan Selanjutnya

No. Pemeriksaan	Tgl. Periksa	No. Registrasi	Jenis Kunjungan	Nama Pasien	Umur	Kunjungan	Keluhan	Pemeriksaan Fisik	Rujuk Lanjut
PM/2008/4/1	20/08/2014	U0001	Cemas	Cemas	27	Ulama	tidak ada		

Kode_Diagnosa	Kode_Diagnosa	Nama_Diagnosa	No. Pendaftaran	No. Registrasi	Kode_Diagnosa	Kode_Pelayanan	Nama_Pelayanan	Tgl.	No. Pemeriksaan
F 2h	Medung Gigi	PM/2008/4/1	Reg/2008/4/2/1	U0001	1 2C1	Cekup Gigi	1000 PM/2008/4/3		

No. Resep	No. Resep	Kode Obat	Nama Obat	Dosis	Jumlah	No. Pemeriksaan

Fig. 9. Examination form

No. Rekam Medis:

No. Registrasi:

Nama Pasien:

Umur:

Buttons: Cetak Rekam Medis

No. Rekam_medis	No. Registrasi	Nama Pasien	Pekerjaan	Tgl. Lahir
RM/BA001	BA001	Arifn Putra		20/07/2014

No. Pemeriksaan	Tgl. Periksa	Jenis Kunjungan	Kunjungan	Keluhan	Pemeriksaan Fisik	Rujuk Lanjut	No. Pendaftaran
PM-2008/4-7	25/08/2014	Poli	(JENAC)	(JENAC)	(JENAC)		Reg-2008

Kode_Diagnosa	Kode_Diagnosa	Nama_Diagnosa	No. Pendaftaran	No. Registrasi
F 2h	(JENAC)	PM-2008/4-2	Reg-2008/4-2-2	BA001

Kode_Diagnosa	Kode_Pelayanan	Nama_Pelayanan	Tgl.	No. Pemeriksaan	No. Pendaftaran
10 2P1	(JENAC)	30000 PM-2008/4-2		Reg-2008/4-2-2	Reg-2008/4-2-2
11 2C1	(JENAC)	10000 PM-2008/4-2		Reg-2008/4-2-2	Reg-2008/4-2-2

No. Resep	No. Resep	Kode Obat	Nama Obat	Dosis	Jumlah	No. Pemeriksaan
D.R3.1	R3	A4	Amoxicillin 500 mg	(JENAC)	1 Pcs	1 Pcs
D.R3.2	R3	A3	Amoxicillin 500 mg	(JENAC)	1 Pcs	1 Pcs

Fig. 10. Medical record form

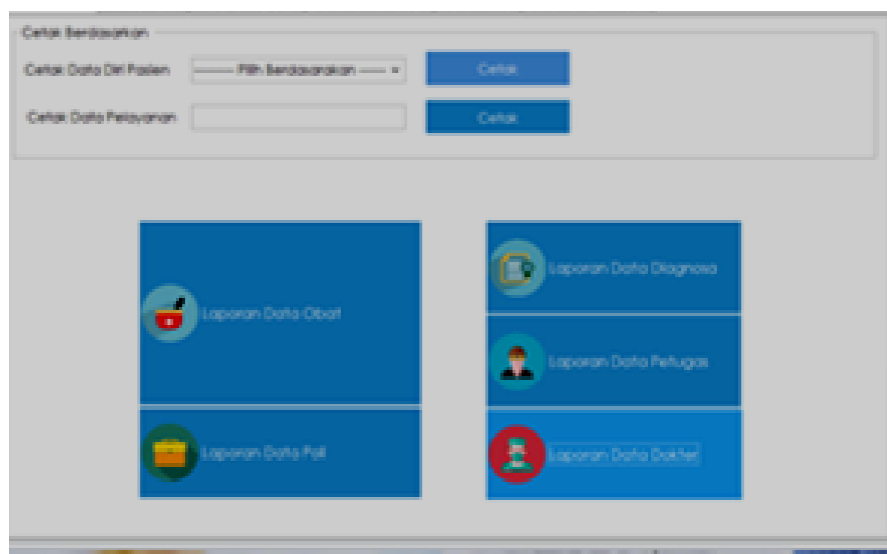


Fig. 11. Print report page

Based on the system that has been built and developed then the researcher asks questions to the experts, experts here are people who can provide information about research data. There are 5 experts involved in this study who use the Medical Record Management Information System at XYZ health facilities. The distribution of the questionnaire has 5 alternative answers based on the Likert scale, while the variables used according to ISO 9126 have 2 variables with a total of 7 questions. The variable in ISO 9126 is between functionality and reliability.

The validity test is used to find out how valid the questions or statements are given to respondents to get something [16]. One of the techniques used to measure validity is the Pearson Product Moment technique [17]. Then the significance test is carried out with the criteria using r_{tabel} at the 0.05 significance level with a 2-sided test. If the value is positive and $r_{hitung} \geq r_{tabel}$ then the item is declared valid and if $r_{hitung} < r_{tabel}$ then the item is declared invalid.

Table 2. System validation results

No	Characteristics Quality	Sub-Quality characteristics	Score
1	Functionality	Suitability: The ability of the software to provide a set of functions suitable for specific tasks and user purposes	82
		Accuracy: The software's ability to provide precise and correct results as needed.	83
		Security: The ability of the software to prevent unwanted access, against intruders (hackers) and authorization to modify data	83
		Interoperability: The ability of the software to interact with one or more specific systems	75
		Compliance: The ability of the software to meet standards and requirements according to applicable regulations	78
2	Reliability	Maturity: The ability of the software to avoid failures as a result of errors in the software	80
		Fault tolerance: The ability of the software to maintain its performance in the event of a software glitch	80
		Recoverability: The ability of the software to rebuild performance levels in the event of system failure, including data and network connections	80

Table 3. Value conversion scale

Value Achievement	Interpretation
$90 \leq x$	Very good
80 - 90	Good
70 - 80	Enough
60 - 70	Less
$x \geq 60$	Very less

$x = \text{Test Result Value}$

Based on expert testing conducted by 5 examiners, the average test value is obtained in Table 2.

The average value of the validation test process by 5 examiners obtained a total value of 82, then compared with the conversion table based on the reference value conversion from ISO 1926 in Table 3.

Based on the results of the above-average value obtained from the validation test carried out on 3 expert examiners, it can be concluded that the application for the validation system for the validation and distribution of this letter has met the ISO 9126 standard with an average good interpretation of a total value of 82, and according to be able to simplify the process of Patient Medical Record Data Management without neglecting the safety aspects of the validation and distribution process, minimizing data loss, simplifying the reporting process and facilitating the processing of patient medical record data.

ACKNOWLEDGEMENTS

Thank you to the Indonusa Polytechnic of Surakarta, especially the Health Information Management Undergraduate Program and D3 Information Management for supporting the completion of this research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Triaji YW, Kridalukmana R, Widiyanto ED. Pembuatan Sistem Informasi Manajemen Klinik dengan Rekam Medis: Studi Kasus di Klinik Kebon Arum Boyolali. *J. Teknol. dan Sist. Komput.* 2017;5(1):15.
2. Pusparani C, Priyambadha B, Arwan A. Pembangunan Sistem Aplikasi Rekam Medis Elektronik Dan Pendaftaran Pasien Online Berbasis Web Studi Kasus Klinik Medis Elisa Malang. *Pengemb. Teknol. Inf. dan Ilmu Komput.* 2019;3(2):1458–1463.
3. Haskas Y, Kadrianti E, Rahantalin VH. Evaluasi Pelaksanaan Manajemen Patient Safety Di Ruang Perawatan Rumah Sakit Umum Daerah Pangkep. *J. Ilm. Kesehat. Diagnosis.* 2019;14(3):223–227.
4. Esraida, Napitupulu B. Analisis Ketidaklengkapan Dokumen Rekam Medis Menurut Standar Akreditasi Rumah Sakit Mki 19.1 Versi Kars 2012 Di Rumah Sakit Umum Imelda Pekerja Indonesia (Rsu Ipi) Medan Tahun 2018. *J. Ilm. Perekam Dan Inf. Kesehat.* 2019;4(1):533–536.
5. Ramadani NNH. Perancangan Sistem Informasi Rekam Medis Puskesmas Sukamerindu. *Edik Inform.* 2019;6(1).
6. Astuti DNFP, Ratnasari CI, Kusumadewi S. Implementasi Sistem Rekam Medis Elektronik Klinik Sehat Kota Salatiga. In *SNIMed.* 2019;59–65.
7. Widiyanto WW. Analisa Metodologi Pengembangan Sistem Dengan Perbandingan Model Perangkat Lunak Sistem Informasi Kepegawaian Menggunakan Waterfall Development Model, Model Prototype, dan Model Rapid Application Development (RAD). *Inf. Politek. Indonusa Surakarta.* 2018;4:34–40.
8. Alshamrani A, Bahattab A. A comparison between three SDLC models Waterfall model, Spiral model, and Incremental/Iterative model. *IJCSI Int. J. Comput. Sci. Issues.* 2015;12(1):106–111.
9. Dima A M, Maassen MA. From waterfall to agile software: Development models in the IT sector, 2006 to 2018. Impacts on company management. *J. Int. Stud.* 2018; 11(2):315–326.
10. Hasriani A, Arty IS. Kontribusi Motivasi, Penguasaan Informasi Dan Persepsi Mahasiswa Pendidikan Kimia Terhadap Kesiapan Implementasi Kurikulum 2013. *J. Inov. Pendidik. IPA.* 2015;1(2):115.

11. Muthia DA, Ramadhani A, Kurniawan A, Irfansyah R. Online student admission application at SMK Al-Basyariah Bojong Gede. Sinkr On. 2019;3(2):61.
12. Noviyarto H, Sari YS. Testing and implementation outpatient information system using ISO 9126. Int. Educ. J. Sci. Eng. 2019;2(3):11–17.
13. Wang G, Bernanda DY, Andry JF, Fajar AN, Sfenrianto. Application development and testing based on ISO 9126 framework. J. Phys. Conf. Ser. 2019;1235(1).
14. Padayache I, Kotze P, Van Der Merwe A. ISO 9126 external systems quality characteristics, sub-characteristics and domain specific criteria for evaluating e-Learning systems. J. Less-Common Met. 1991;168(2):257–267.
15. Stefani A, Xenos M. E-commerce system quality assessment using a model based on ISO 9126 and belief networks. Softw. Qual. J. 2008;16(1):107–129.
16. Yusup F. Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. J. Tarb. J. Ilm. Kependidikan. 2018;7(1):17–23.
17. Yunika N, Novianti R, N Z. The correlation between self concept and moral behavior. 2020;1(1):1–10.

© 2020 Widiyanto and Wulandari; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

*The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/60968>*