

## Original Research Article

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

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### 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 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. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY**

### **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] [8] [9]–[11].

The five main stages of the waterfall model are shown in Figure 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.

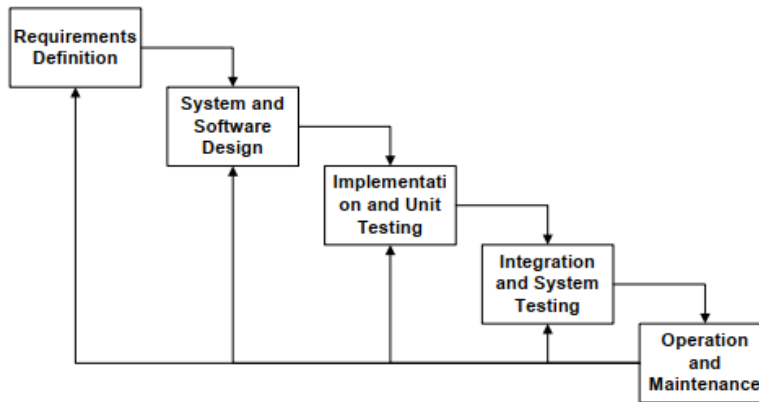
#### **2.1.3. Implementation and unit testing**

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



**Fig. 1. The Waterfall Model**

### 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 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] [13] [14] [15].

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 [(Arial, normal, 10 font, justified) (Detailed instruction about this section is given below. After reading these instructions, please delete this paragraph and begin typing your text here. If you are using a copy-paste option then select 'match destination formatting' in the paste option OR use 'paste special' option and select 'unformatted Unicode text' option)].

Give adequate information to allow the experiment to be reproduced. Already published methods should be mentioned with references. Significant modifications of published methods and new methods should be described in detail. This section will include sub-sections. Tables & figures should be placed inside the text. Tables and figures should be presented as per their appearance in the text. It is suggested that the discussion about the tables and figures should appear in the text before the appearance of the respective tables and figures. No tables or figures should be given without discussion or reference inside the text.

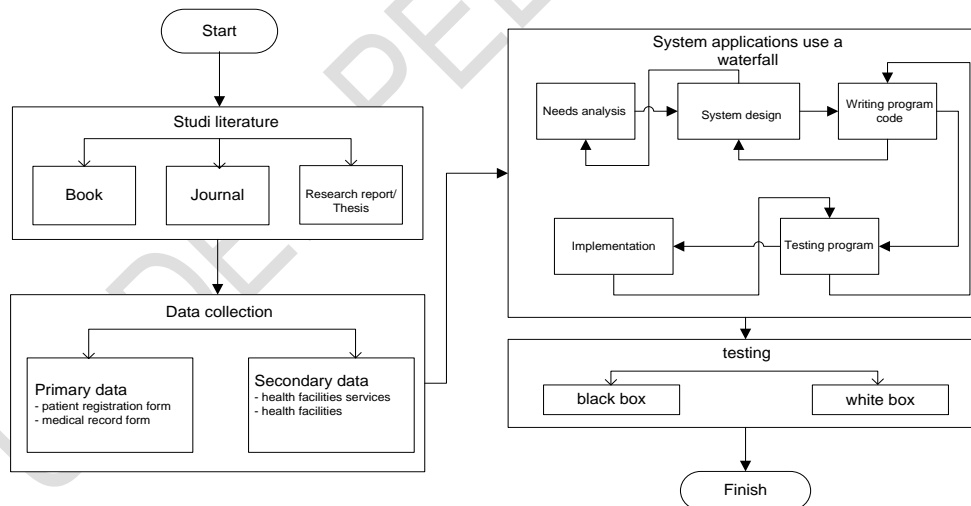
Tables should be explanatory enough to be understandable without any text reference. Double spacing should be maintained throughout the table, including table headings and footnotes. Table headings should be placed above the table. Footnotes should be placed below the table with superscript lowercase letters.

**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 Figure 2. Below



**Fig. 2. Research Flow**

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

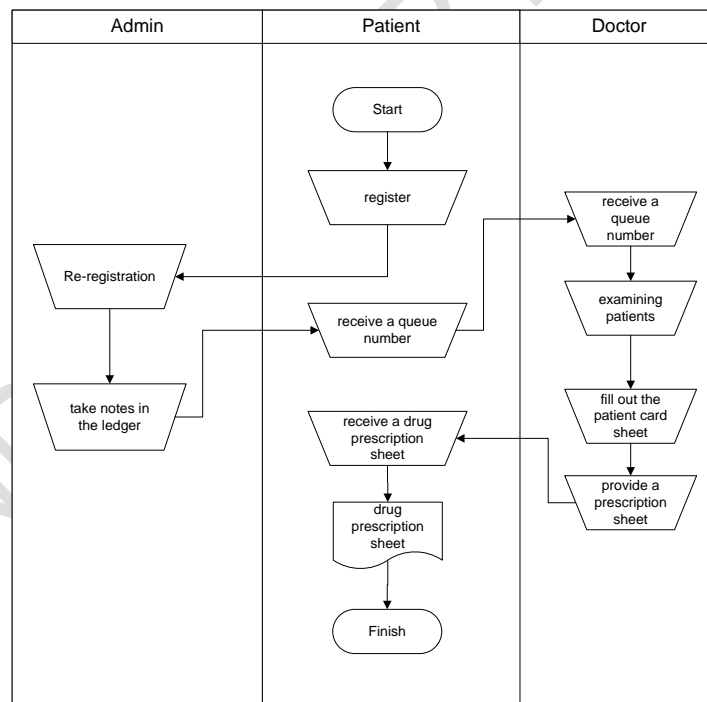
- i) Determining the background of the problem, this stage is the initial stage in research where the background of the problem can help in determining the goals and targets that must be achieved from the research carried out. This research was started from a literature study after finding the problems 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.

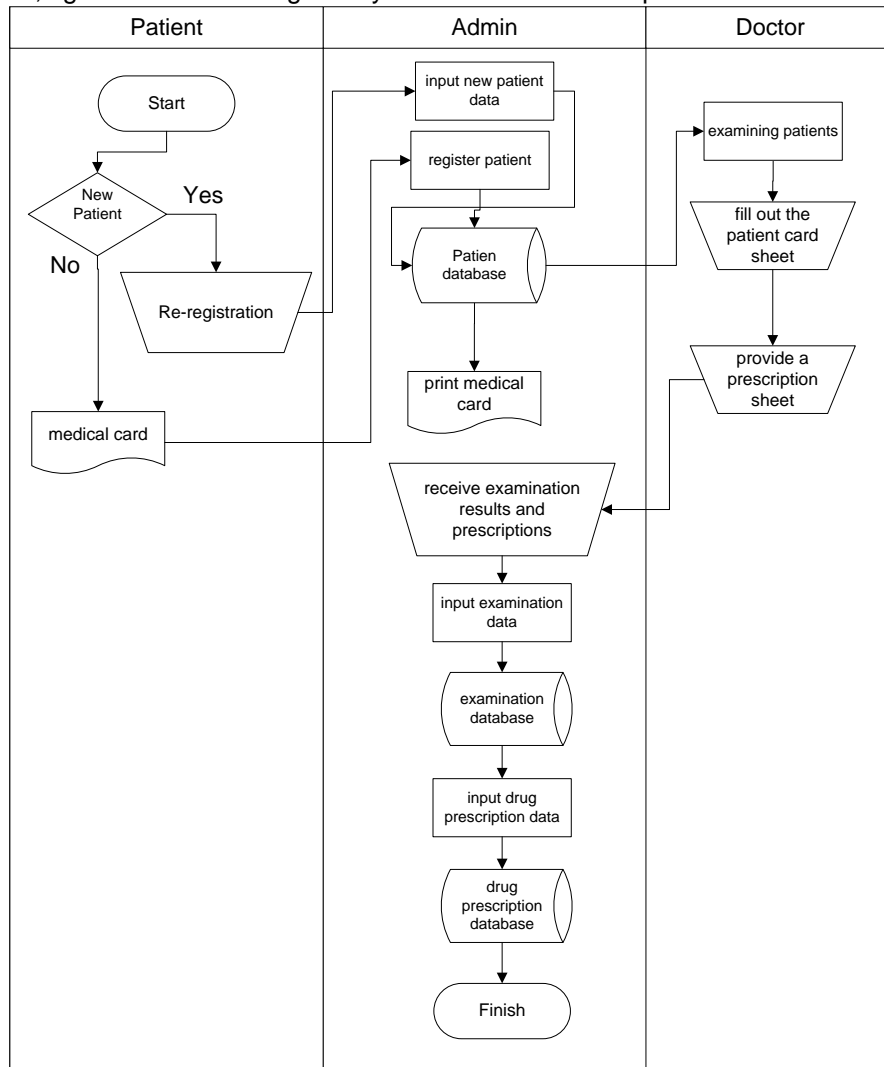
From these problems, it can be concluded that the main cause of problems that occurred in XYZ health facilities in managing patient data is still using the old system, namely the ledger. The flow is illustrated in Figure 3. below:



**Fig. 3. Manual Patient Data Management**

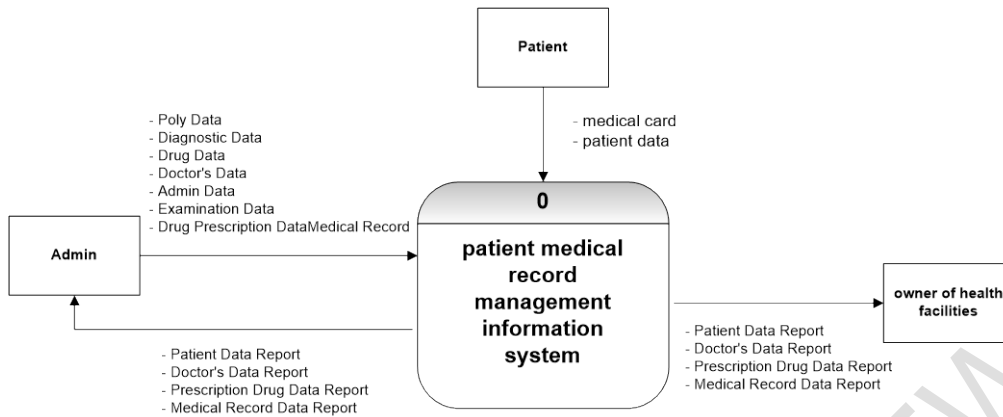
After getting an overview of patient data management manually, the researcher then develops a system with a reference to the new system that must have a good, correct, and clear system design. The procedures in the system being developed are almost the same as

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, figure 4. the following is a system flowchart developed:



**Fig. 4. Flowchart System Developed**

The implementation of the figure above is then made a system context diagram in Figure 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

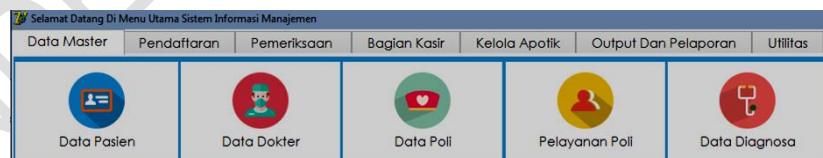


**Fig. 5. Context Diagram**

#### 4. CONCLUSION

The implementation of the Medical Record Management Information System is shown in Figures 6, 7, 8, 9, 10, and 11 as follows:

**Fig. 6. Login Form**



**Fig. 7. System Menu**

Input Data Pasien

No. Registrasi: 2014-07-00  
 Tgl. Registrasi: 2014-07-00  
 Jenis Pendaftaran: Poli. Pendaftaran  
 No. KK: [ ]  
 Nama KK: [ ]  
 No. BPJS: [ ]  
 Nama BPJS: [ ]  
 Nama Pasien: [ ]  
 Status: [ ]  
 Pekerjaan: [ ]  
 Alamat: [ ]  
 No. Telp: [ ]  
 Tempat Lahir: [ ]  
 Tgl. Lahir: 2014-07-00  
 Umur: [ ]  
 Jenis Kelamin: [ ]

Caril Berdasarkan: Caril Berdasarkan  
 Karty Pendaftaran: [ ]

No. Registrasi	Pendaftaran	Tgl. Reg	No. KK	Nama KK
SA0001	SP.J. Kesehatan	05-06-2014	3000000000-00	Adi Atkawan
SA0001-1	SP.J. Kesehatan	05-06-2014	3000000000-00	Adi Atkawan
SA0001-2	SP.J. Kesehatan	05-06-2014	3000000000-00	Adi Atkawan
SA0001	SP.J. Keharogakerasan	05-06-2014	2001020100010000	Adi Atkawan
SA0001	LAJUM	05-06-2014	27632200000000	Adi Atkawan

Buttons: Simpan, Kembali, Cetak Kartu Pendaftaran, Cetak Kartu Berobat

Fig. 8. Patient Data Entry Form

Data Pemeriksaan

No. Pemeriksaan: PMA20014-3  
 No. Pendaftaran: Reg20014-01  
 No. Registrasi: 000001  
 Nama Pasien: Bambang Supriyanto  
 Umur: 27  
 Jenis Kelamin: [ ]  
 Kurung: Poli. Kurung

Keluhan: [ ]  
 Pemeriksaan Fisik: [ ]  
 Riwayat Penyakit: [ ]

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

Buttons: Pemeriksaan Selesai, Pemeriksaan Selanjutnya

No. Pemeriksaan	Tgl. Periksa	No. Registrasi	Jenis Kelamin	Nama Pasien	Umur	Kurung	Status	Pemeriksaan	Rekam Medis
PMA20014-3	20/07/2014	000001	Pria	Bambang Supriyanto	27	Poli.	Selesai	10000	10000

Kode	Definisi	Kode	Diagnosa	Nama	Diagnosa	No. Pemeriksaan	No. Pendaftaran	No. Registrasi
F 26		(MENC)				PMA20014-3	Reg20014-01	000001

Kode	Definisi	Kode	Pelayanan	Nama	Pelayanan	Tarif	No. Pemeriksaan	No. Pendaftaran
10	JP1	(MENC)				3000	PMA20014-2	Reg20014-2-2
11	JP1	(MENC)				10000	PMA20014-2	Reg20014-2-2

No. Defensep	No. Resep	Kode	Obat	Nama	Obat	Dosis	Jumlah	No.
003.1	R3	A4	Amoxicillin	Tipe ST	(MENC)		1	Per
003.2	R3	A3	Amoxicillin	TY	(MENC)		1	Per

Fig. 9. Examination Form

No. Rekam Medis: PMA20001  
 No. Registrasi: SA0001  
 Nama Pasien: Adi Atkawan  
 Umur: 3

Buttons: Cetak Rekam Medis

No. Rekam medis	No. Registrasi	Nama Pasien	Pekerjaan	Tgl. Lahir
PMA20001	SA0001	Adi Atkawan		20/07/2014

No. Pemeriksaan	Tgl. Periksa	Jenis Kelamin	Kurung	Keluhan	Pemeriksaan Fisik	Riwayat Penyakit	No. Pendaftaran
PMA20014-3	20/07/2014	Pria	(MENC)	(MENC)	(MENC)		Reg20014-01

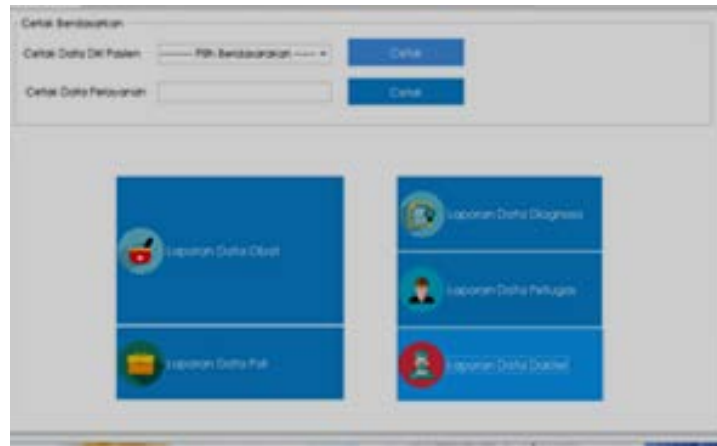
Kode	Definisi	Kode	Diagnosa	Nama	Diagnosa	No. Pemeriksaan	No. Pendaftaran	No. Registrasi
F 26		(MENC)				PMA20014-3	Reg20014-2-2	SA0001

Kode	Definisi	Kode	Pelayanan	Nama	Pelayanan	Tarif	No. Pemeriksaan	No. Pendaftaran
10	JP1	(MENC)				3000	PMA20014-2	Reg20014-2-2
11	JP1	(MENC)				10000	PMA20014-2	Reg20014-2-2

No. Defensep	No. Resep	Kode	Obat	Nama	Obat	Dosis	Jumlah	No.
003.1	R3	A4	Amoxicillin	Tipe ST	(MENC)		1	Per
003.2	R3	A3	Amoxicillin	TY	(MENC)		1	Per

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.

Based on expert testing conducted by 5 examiners, the average test value is obtained in table 2. as follows:

**Table 2. System Validation Results**

No	Characteristics Quality	Sub-Quality characteristics	Score
1	<i>Functionality</i>	<i>Suitability</i> : The ability of the software to provide a set of functions suitable for specific tasks and user purposes	82
		<i>Accuracy</i> : The software's ability to provide precise and correct results as needed.	83
		<i>Security</i> : The ability of the software to prevent unwanted access, against intruders (hackers) and authorization to modify data	83
		<i>Interoperability</i> : The ability of the software to interact with one or more specific systems	75
		<i>Compliance</i> : The ability of the software to meet standards and requirements according to applicable	78

No	Characteristics Quality	Sub-Quality characteristics	Score
2	Reliability	regulations	
		<i>Maturity</i> : The ability of the software to avoid failures as a result of errors in the software	80
		<i>Fault tolerance</i> : The ability of the software to maintain its performance in the event of a software glitch	80
		<i>Recoverability</i> : The ability of the software to rebuild performance levels in the event of system failure, including data and network connections	80

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 as follows:

**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

$x$  = Test Result Value

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.

## Ethical Approval:

As per international standard or university standard ethical approval has been collected and preserved by the authors.

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