ORIGINAL ARTICLE

Hospital Information System Implementation for Biomaterial Product in Tissue Bank: Best Practices and Lesson Learned

Analisa Sawiji Putriyekti[1,2], Elsye Maria Rosa[1]

[1] Master of Hospital Administration Program, Universitas Muhammadiyah Yogyakarta, 55183 Special Centrel of Yogyakarta, Indonesia
[2] Cell and Tissue Bank-Regenerative Medicine, Dr. Soetomo General Academic Hospital, 60285 Surabaya, Indonesia

ABSTRACT

Introduction: Biomaterials are materials from natural or synthetic sources, used to strengthen or replace part or all of the body's tissues. Tissue Bank is the unit in Dr Soetomo Hospital that produces products biomaterial from human tissue. According to the standard, biomaterial products must be able to be traced quickly and accurately. Therefore, the tissue bank has been developing an Information System for Biomaterial Products (ISOMERIC). Implementation of the information system is not always successful, as well as ISOMERIC, so an evaluation is needed. This research aims to explore the best practices and lessons learned from the implementation of ISOMERIC. **Materials and methods:** The method of this study is qualitative. In-depth interviews were conducted with 14 respondents. The research instrument was developed by Human, Organization, and Technology Fit (HOT-Fit) framework. **Results:** The implementation of ISOMERIC was still 20%. Factors that lead to the implementation of ISOMERIC include support from the hospital, the Person In Charge (PIC), training, system security, user acceptance, easy system interface, and trouble and improvement handling. Factors causing a delay in implementing ISOMERIC on time include the priority of implementation, internal Tissue Bank problem, and lack of infrastructure. **Conclusion:** ISOMERIC implementation has faced challenges. Positive factors such as organizational support, and user training contribute to its ongoing progress. The challenges during ISOMERIC implementation such as lack of management support, adequate preparation, and collaboration with other institutions. Tissue Banks can develop better strategies for successful ISOMERIC implementation and improve biomaterial production standards.
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Corresponding Author:
Analisa Sawiji Putriyekti, Master
Email: putriyekti21@gmail.com
Tel : (031) 5038335

INTRODUCTION

Biomaterials are materials or combinations of materials from natural or synthetic sources that are used to strengthen or replace part or all of the body's tissues to improve the quality of life of individuals(1,2). Biomaterials can permanently fuse with tissues or promote their regeneration (3). The gold standard for tissue transplantation comes from the patient's own body (autograft), but due to the limitations of the tissue taken and the morbidity in the part, the replacement tissue is taken from the body of another person (allograft). If allograft tissue is not available, then replacement tissue can be taken from animals (xenograft) or synthetic materials. Allograft tissue has the advantage of low risk of immune rejection because it comes from humans(4). The disadvantages of allograft are the limited number of donors and the risk of disease transmission. Tissue Bank is one of the units in Soetomo General Hospital, a nonprofit organization that provides biomaterial product services for medical purposes. In Indonesia there are 3 Tissue Banking : Padang (M. Jamil Hospital), Jakarta (Badan Tenaga Atom Nasional) and Surabaya (Dr Soetomo General Hospital). The Tissue Bank at Dr. Soetomo General Hospital has produced biomaterial products, especially those made from human tissue made from human tissue.

Activities carried out in tissue banks include donor procurement, processing, storage, and distribution of human tissues for medical purposes. Tissue Bank-Soetomo General Hospital has produced products from human tissue which is unused tissue that remains, such as amnion membrane and remnant bone after surgery. Remnant tissue can be reprocessed into products that can be used to repair or replace body tissues that are damaged or lost due to trauma, injury, or disease. It comes from humans so remnant tissue has active substances that stimulate the process of restoring

damaged tissue (5,6). Biomaterial products from human tissues have many benefits and have the potential to be further developed for tissue engineering products (3,7,8) so the quality and quantity of biomaterial products must be improved.

Tissue bank-Dr Soetomo General Hospital started producing biomaterial products in 2007. All activities are recorded in paper documents. The challenges of using paper documents include difficulty in finding information quickly and accurately. Challenges in storage, risk of damage or loss, and difficulty of control(9). Tissue products must have traceability, therefore every tissue product must have a Tissue Identification Number. It is a combination of numbers, letters, and or symbols on the tissue product that contains information about the collection, processing, packaging, labeling, storage, and distribution of the tissue(1). The complete information that must be listed in the Tissue Identification Number makes it difficult for Tissue Bank- Dr. Soetomo General Hospital to manage information to ensure every tissue product has traceability. So it is necessary to improve all information about donor procurement, processing, packaging, labeling, storage, and distribution of the tissue product that is efficient, fast, easy, and accurate with the information system. The information system for product biomaterials (ISOMERIC) is part of the Hospital Information System (HIS) at Dr. Soetomo General Hospital. The system aims to facilitate recording activities completely and in real-time, bring order to activities, increase control of activities in real-time, facilitate the accessibility of products, and provide data fast and accurately. (1,10,11).

HIS has been implemented in several countries such as Iran, Ethiopia, Angola, Croatia, Canada, Germany, Pakistan, and Indonesia. Lack of resources, lack of management support, unfamiliarity with computers, data security, and usability issues are some of the obstacles to HIS implementation that limit implementation (12–18). These obstacles cause the implementation of HIS to be not maximized, which means that the purpose of HIS to increase the effectiveness and efficiency of health service is not achieve. So an evaluation is needed in the implementation of HIS, including ISOMERIC. This study aims to explore the supporting and failure factors of ISOMERIC implementation by using the human, organizational, and technology-fit (HOT-Fit) framework. Besides that, it provides suggestions and recommendations for improving the implementation of information systems, especially in health services.

MATERIALS AND METHODS

Study Design

This study used a qualitative design with a phenomenological perspective. This perspective focuses on exploring how individuals understand a topic and provides an in-depth account of the subjective experience of those individuals (19). HOT-Fit Framework states that the successful implementation information system depends on a fit between human, organizational, and technological factors. The HOT-Fit framework was used as a reference to create a research instrument. In the Human aspect, there are two dimensions: system use and user satisfaction. In the Organization aspect, there are two dimensions: structure and environment. In the Technology aspect, there are three dimensions: system quality, information quality, and service quality. All dimension is used to measure the net benefit of the system.The relationship about all aspect in HOT-Fit Framework can be seen in Fig. 1.

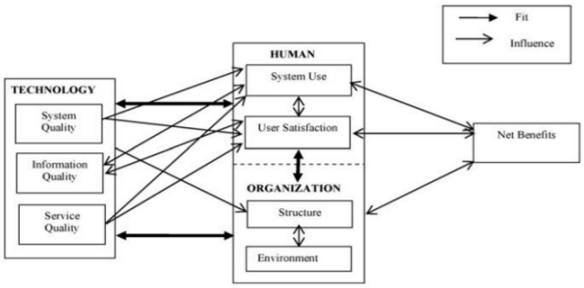

Fig. 1: The relationship about all aspect in HOT-Fit Framework

Participant

Participants in this study were selected based on purposive sampling by selecting respondents who understand the research problem. Inclusion criteria were participants who used and associated with ISOMERIC. That includes Tissue Bank staff from the biomaterial division with a total of 8 participants. The ISOMERIC developer is a staff from the Technology, Communication, and Information (ICT) Unit- Dr. Soetomo General Hospital with a total of 6 participants. Exclusion criteria are participants who do not use or are not related to the implementation of ISOMERIC.

Research Instrument

The Research Instrument is interview guidance whose questions are arranged based on variables from each dimension can be seen in Table I.

Table I: Dimention of Each HOT-Fit Framework

Framework	Dimension	Variabel
Human	System Use	Level of use, knowledge
	User Satisfaction	Perceived usefulness, user satisfaction
Organization	Structure	Top management support, strategy
	Environment	Communication, competition
Technology	System Quality	Easy of lerning, easy of use, respon time, security
	Information Quality	Accurancy, completeness, availability, timeliness, compatibility
	Servis Quality	Responsiveness, emphaty, follow-up service, assurance

Data Collection and Analysis

The data in this study came from observations and in-depth interviews with participants. Observations were conducted from May until July 2023. Interviews with participants were conducted on August 2023 until September 2023. Interviews were conducted based on the interview guide that had been prepared. The results of the observations and in-depth interviews were then analyzed with the NVivo application.

Ethical Clearance

This study was reviewed and approved by the Etic Committee of the Dr Soetomo General Hospital with reference number: 0711/KEPK/VII/2023.

RESULTS

In-depth interviews have been conducted with 14 participants related to the system, such as users and system developers. Information about the characteristics of participants can be seen in Table II.

Table II: Characteristic of Respondent

Age	Frequency	Presentation
20-29	5	35,7%
30-39	7	50%
40-49	1	7,14%
50-59	1	7,14%
Sex		
Male	3	21,4%
Female	11	78,5%
Education		
Senoir High School	3	21,4%
Diploma	2	14,2%
Bachelor	6	42,8%
Master	3	21,4%
Unit		
Tissue Bank	8	57,1%
ICT	6	42,8%

ISOMERIC is part of HIS Dr. Soetomo which supports the documentation of all production activities and product services of biomaterial products. This system is designed with major changes to the biomaterial product business process. These changes include changes in work documents, changes in organizational structure, changes in Standard Operating Procedures (SOP), and improvements in the flow of activities. These changes refer to the Standard Asia Pacific Association Tisse Bank (APASTB) and National Food and Drug Agency Number 18 of 2022 concerning Good Manufacturing Practices (GMP) in Human Cell and Tissue-Based Product Processing Facilities. The Tissue Bank Unit collaborates with the Information, Communication, and Technology (ICT) Unit-Dr Soetomo Genaral Hospital to develop this system. The biomaterial product business process in ISOMERIC can be seen in Fig. 2.

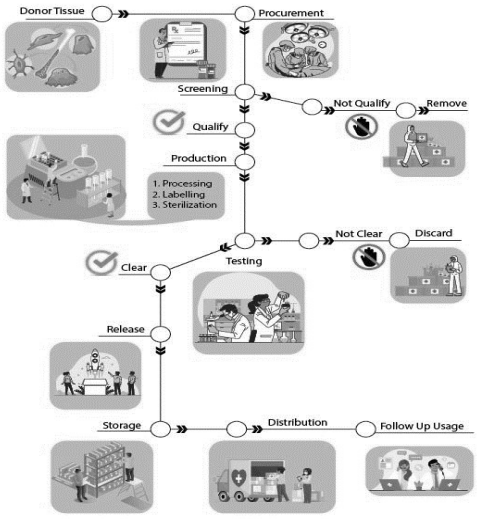

Fig. 2: The biomaterial product business process in ISOMERIC

ISOMERIC implementation is carried out step by step according biomaterial business process (Figure 2). Each stage has specifications that must be completed to proceed to the next stage. Before using the system, documentation at the Tissue Bank was used as a document paper. The disadvantages of document paper include not real-time documentation, difficulty in storing and controlling documents, coordinator verification is not real-time, difficulty in searching for products, and difficulty in making fast and accurate reports. ISOMERIC can be implemented starting January 2023, by the program of Dr Soetomo General Hospital to use an independent information system for all units starting January 1, 2023. However, implementation of ISOMERIC started in July 2023, which means 6 months late from the plan. Until the in-depth interviews were completed in September 2023, ISOMERIC implementation had only reached the screening stage, meaning only 20% had been implemented. The factors that caused this system to be implemented can be seen in Fig. 3.

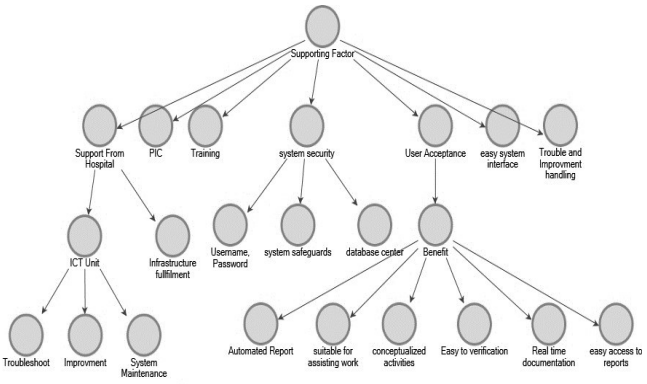

Fig. 3: Support Factor Implementation ISOMERIC

Support From Hospital

Dr Soetomo General Hospital supports the independent

information system. Information, Communication, and Technology (ICT) unit that functions to develop, make improvements, handle troubleshooting, and maintain the system. Independent System Information, of course, requires large resources, so the hospital recruited 50 employees aged 20-35 years old in November 2023 to prepare for this. These employees are divided according to the organizational structure in the ICT Unit to facilitate the implementation of independent system information at Soetomo General Hospital.

"I think the hospital supports the use of this system because the hospital provides facilities such as the internet, computers and then manages this system through the ICT Unit" (Participant 13)

"In November 2022, we recruited 50 employees to prepare for the implementation of information system in Dr Soetomo General Hospital. The majority of them are young, in the range of 20-35 years old, so that they can respond quickly. Then they will be divided according to the organizational structure" (Participant 9).

In addition, the infrastructure from the Tissue Bank to use this system such as computers and printers has been fulfilled although the number is still lacking.

Person in Charge (PIC)

The PIC is a bridge between the ICT Unit and the Tissue Bank in the implementation of ISOMERIC. The PIC coordinates with the ICT Unit regarding the urgency of using the system and helps staff at Tissue Bank to adapt to the ISOMERIC. The PIC also identifies obstacles during implementation and communicates with the ICT Unit or other units to find solutions.

"The person in charge of implementation from the Tissue Bank as a bridge that interprets user needs to ICT Unit, as a needed in reality. Without PIC, this implementation could be messy" (Participant 3)

"ICT Unit do not know how urgent this system is to be used. So we need coordination to PIC implementation. Coordination is also important, because we don't know whether this system is suitable for covering the needs at the Tissue Bank, if it hasn't covered, we can improve the system according to the needs in Tissue Bank" (Participant 9).

System Security

ISOMERIC is part of the Hospital Information System Dr Soetomo, so the security of the ISOMERIC system will be the same as the security of the entire HIS. Users must have a specific username and password to access the system, which is only known by the user.

"I access it by entering my username and password, then I can choose the menu. Only I know the username and password" (Participant 13).

System security is managed by the ICT Unit. Security is used in the form of applications such as firewalls and antivirus. Firewall serves to prevent physical attacks from outside and antivirus serves to protect the system from damaging virus attacks.

"The information system in this hospital uses Firewall security to prevent attacks from outside (heckers) and then there is also antivirus. the database is also coded so that it cannot be read by heckers. The database storage location, we also store it in two places to prevent damage or disaster." (Participant 9)

Data that has been entered into the system will then be stored in the database. The database is stored in the Data Center Room. Dr. Soetomo General Hospital facilitates the room with a fire suppression system, fire detector, fire print, close circuit television (CCTV), and temperature monitoring. Only officers with certain access rights can enter this room. Databases are stored in 2 places in anticipation of damage or disaster.

User Acceptance

ISOMERIC can show reports automatically. Reports are generated according to what users enter into the system. The information system Dr Soetomo General Hospital has been designed with high accuracy so that it can produce consistent data. ISOMERIC is also suitable for assisting work because it has been designed based on existing business processes in the Tissue Bank, with some development to order the flow of activities. Coordinators, most of whom are surgeons and are not on standby at the Tissue Bank, can perform verification to monitor the production activity in Tissue Bank. ISOMERIC makes it easy for coordinators to verify and can be accessed anywhere within the hospital.

"I always use this system to input donor data" (Participant 8)

"I will use this system because it will make my task easier to monitor activities at the Tissue Bank because I am a surgeon who is not always available at the Tissue Bank" (Participant 7).

Trouble and Improvement Handling

If ISOMERIC has trouble, the user can contact the ICT Unit. Trouble that often occurs in infrastructure such as printers and trouble on the system. In the trouble-handling procedure, users can contact the ICT Unit helpdesk.

"Users can contact the IT Hotline if there are complaints or problems with the system although slow to respond" (Participant 9)

In reality, if there is trouble, the user in the Tissue Bank will contact PIC, then PIC will forward it to the ICT Unit.

"If there is a problem with the system, I report it to the PIC and then the PIC to the ICT Unit"(Participant11)

This method is considered faster for users to contact the ICT Unit than the helpdesk. Then the ICT Unit will respond and send its staff to immediately fix the problem. After it is resolved, ICT staff will provide direction on how to use the system or infrastructure so that it does not trouble again.

"…we give a instructions to use the system properly to the user. For example, if the use is not reasonable, there will be trouble again. We do this to prevent trouble again, so users can be more careful" (Participant 4)

If ISOMERIC requires improvement to adapt to current conditions, then PIC will design changes for further improvement by the ICT Unit. This improvement also takes time, if the change is minor then the improvement will be completed in 2 days. But for major changes such as changing the flow of activities, the improvement takes a maximum of 2 weeks.

"We make improvements to the system based on the scope. If the improvement is moderate to light, it doesn't change much or doesn't require much effort, it can be done immediately. But if the improvement is medium to high such as changing the flow or changing the flow in the middle or adding a new menu then it needs approval from our superiors. After that, it can only be done. For the time to improve 2 days is already fast and the longest is 2 weeks" (Participant 3)

Easy System Interface

The system interface is designed to be as simple as possible to make it easier for users to use this system. The language used is Indonesian. The system display consists of 4 large menus, such as master, transactions, information, and reports. In the menu, there is a sub-menu that is hidden and will only appear when the user accesses it. This makes the system display easier.

"The system interface is made easy so that users are easier to use" (Participant 10)

"The system is easy to use because it uses Bahasa Indonesia. The menu is also simple" (Participant 1)

Training

Training on the use of ISOMERIC was conducted in February 2023. This training was attended by all biomaterial division staff held at the Tissue Bank. The training was conducted by the ICT Unit and assisted by the PIC. After the training, the ICT Unit conducts assistence, similar to training but with a shorter time duration. Assistance is carried out until the user is accustomed to using the system.

"Training to use this system has been carried out on February 3, 2023. It was a full day of training. After the training there is assistance with a duration of not long, at most 1-2 hours" (Participant 3).

The implementation of ISOMERIC was not as planned. Factors causing the failure to implement ISOMERIC on time can be seen in Fig. 4.

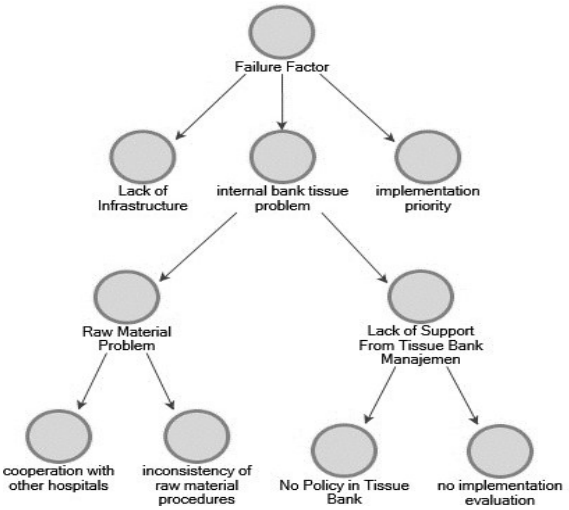

Fig. 4: Failure Factor of Implementation ISOMERIC on Shcedule

Internal Tissue Bank Problem

SIERA could not be implemented as planned in January 2023 due to internal problem at IBJS.

"… I think it is due to internal problems at the Tissue Bank" (Participant 3)

Raw materials from human tissue must complete document requirements including informed consent, informed consent, screening form, medical history form, and laboratory results (HIV, HBsAg, Syphilis). ISOMERIC has been set up so that only qualified raw materials can be processed, raw materials that do not complete document requirements cannot be produced.

"We have made specifications for tissue raw materials that can be accepted, such as the existence of inform consent documents, inform to consent screening sheets, medical history sheets and laboratory results. the system also requires this so that raw materials that do not meet specifications cannot proceed to the next stage" (Participant 1)

So far, all tissue raw materials have always entered production because they come from donated materials so must be utilized as much as possible. However, the

new standard requires that each raw material must have a specification, and all tissue raw materials must comply with the requirements before processing. This screening stage is important to ensure the quality of the tissue before it is produced. The consequence of implementing this new procedure is that unqualified tissue cannot be processed.

"...because almost all the materials we receive do not meet the material acceptance requirements" (Participant 8)

This will certainly have an impact on reducing the amount of production. So the policy of the Leader of the Tissue Bank became inconsistent in implementing the new procedure. ISOMERIC only helps to make the new procedures on tissue handling more consistently applied.

"…there is policy inconsistency. We have had a long discussion about this. And we have entered it in the system, so we make it mandatory for this donor requirement. But until now the donor requirements are also still being bargained…" (Participant 7).

"The specifications and procedures for receiving raw materials have not been implemented properly because the policy of management are not consistent. We have planned to receive raw materials as written in the procedure but the management policy is different, so it seems inconsistent with the procedure that was once made" (Participant 8).

Tissue raw materials are obtained not only from Dr Soetomo General Hospital but also from other hospitals. To obtain these requirements, the Tissue Bank needs to collaborate with other hospitals, so that the tissue raw materials when sent are equipped with the document requirements. Of the 10 network hospitals that are scheduled to cooperate in 2022, until October 2023 there are currently only 2 network hospitals that have collaborated. As a result, many raw materials cannot enter the system so they cannot be processed.

" The system only helps us to be more consistent. The requirements for receiving raw materials include informed consent, informed to consent, screening sheets and lab results. All documents can be obtained if we make cooperation with hospitals that usually send tissue raw materials . Only 2 hospitals that have collaborated. We should try to collaborate with other hospitals, so that the donor requirements (as raw material) can be met and can enter the system " (Participant 7).

The target of cooperation with other hospitals has not been achieved because the management in the Tissue Bank is part-time management. The leaders and coordinators in the Tissue Bank are surgeons who are not always at Tissue Bank.

"The coordinator is a doctor, especially a surgeon, not always available at the Tissue Bank. So this is part time at the Tissue Bank" (Participant 7)

Management did not know the problems that occurred in this implementation and also other problems in the Tissue Bank due to lack of communication. Management also could not prioritize the problems to be solved.

".... there are many problems and the discussion is less focused, like there is no prioritization of problems. Sometimes the discussions we want about raw material requirements and cooperation with other hospitals are not discussed, because there are discussions of other issues" (Participant 1).

There is also no evaluation regarding this implementation. Evaluation is only limited to between users and the Person In Charge (PIC).

"…evaluation is mostly between us in Quality Control and the person in charge of implementation. There has never been an evaluation of the implementation of this system at a routine meeting"(Participant 1)

According to the interview results, no policy regulates this system. However, based on document observation, there is a decision of the Director of RSUD Dr. Soetomo Number 188.4/731.6/301/2022 regarding the Tissue Bank Service Policy, which states that the recording of services in the Tissue Bank is carried out in a hybrid manner with 2 manual and electronic methods. Manual documents include documents that require wet signatures from donors and providers. Electronic documents are information systems that provide detailed records of the production, receipt, storage, distribution, and follow-up of biomaterial products. Time constraints from the management have not socialized this policy, so the staff who are participants are not aware of this policy.

"...there is no policy or procedure for using this system" (Participant 12).

"...in here no policy about this system. Maybe because the management is not always here, so the policy on this system is considered less important." (Participant 13)

Lack of management time due to part-time management means that there is no policy on the implementation of this system. Policies function to regulate the use of ISOMERIC and are binding for the staff of Tissue Bank. This is a transition period from not being orderly in receiving raw materials, to having to be orderly in

receiving raw materials. Tissue Bank is trying to adapt to this situation. The lack of focus of management in the Tissue Bank has led to a lack of support so that ISOMERIC can be fully implemented.

"…there is no support from the coordinator or the leadership of Tissue Bank so we go alone. No awareness of using the system for users because there is no support from the leadership" (Participant 11)

"It seems like it needs its own focus to adapt to the new standards, which are already in the system. Surgeons like us cannot always be at the Tissue Bank. So we are less focused on problems in the Tissue Bank including the problem of implementing this system"(Participant 7)

Implementation Priority

Although there are only 3 Tissue Banks in Indonesia, the Tissue Bank at Dr Soetomo Genaral Hospital is a supporting service, average number of patients each day requiring biomaterial products for 3-10 patients. This small number of patients means that problem-solving related to implementation is more focused on units with a larger number of patients, such as polyclinic, inpatient services, and pharmacy. Tissue Bank is not a priority in the implementation of the information system at Dr Soetomo General Hospital.

"... the Tissue Bank service is a supporting service and there are rarely patients compared to other units in this hospital. We prioritize the implementation of information systems in units with many patients." (Participant 5).

"...whereas in the Tissue Bank there are not as many patients as in the policlinic or inpatient department, so we prioritize units with many patients because of our limited manpower" (Participant 9).

Lack of Infrastructure

Infrastructure to support the implementation of this system is still lacking both infrastructure that is directly related and infrastructure that is not directly related to the system.

Infrastructure that is directly related to the use of the system includes computers, ipad, printers, scanners, the number is still lacking so that the implementation of this system is less than optimal.

"We need an ipad or barcode printer so that this system can be implemented for the production menu" (Participant 11)

"We need additional computers, laptops and scanners to make our work easier" (Participant 1)

Infrastructure that is not directly related to the system is a freezer. Tissue raw materials after procurement, both at Dr Soetomo General Hospital and at other hospitals will then be stored in temporary storage freezers to be taken by Tissue Bank officers periodically. To establish cooperation with other hospitals, of course, the infrastructure in the form of freezers needs to be prepared so that the handling of tissue raw materials can run well. This infrastructure does not yet exist for the 10 other hospitals with which cooperation is planned. So far, the storage freezer used is owned by the hospital, not by the Tissue Bank.

"I think facilities need to be added. For example, to run the production menu. Production is done in a special room so it's different from the office. It is necessary to analyze the suitable device, as well as its integration with other devices that support activities" (Participant 4)

DISCUSSION

ISOMERIC is an information system designed with major changes to the existing biomaterial product business process. The changes refer to APASTB and GMP standards. The system aims to bring order to the production and service activities of biomaterial products and ensure traceability.

The implementation of ISOMERIC was 6 months later than the initial plan. Until this research was completed, the implementation of ISOMERIC had already run 20%, reaching the screening stage. In 2006, Yusof et al developed the HOT-Fit framework to evaluate health information systems (20). The framework shall consider human, organizational, and technological aspects. Humans as users of system information. Organization in healthcare serves to prepare its staff to adapt to new technology. Technology serves as support for the running of the information system.

Best Practice From Implemetation ISOMERIC

The purpose of the implementation of ISOMERIC is to comply Standart Asia Pacific Association of Tissue Banking (APASTB) and Good Manufacturing Practice (GMP) for biomaterial production. This system is unique and complex. It is unique because the raw material is donated human tissue that has been wasted but can be reused. This system is similar to the information system in pharmacy, but more complex because of the integration between documents and other departments in Dr Soetomo General Hospital.

Despite being behind schedule, the ISOMERIC implementation was not a complete failure. Until this research was completed, the implementation of ISOMERIC was 20% complete. Factors that support ISOMERIC to be implemented include organizational, human, and technological factors. Organizational factors are the support from the management of Dr Soetomo General Hospital through the ICT Unit assigned to manage the HIS. including ISOMERIC. Dr. Soetomo General Hospital management conducts the

recruitment of new staff to facilitate the implementation of independent information systems and the fulfillment of infrastructure to support the implementation of HIS at Dr Soetomo General Hospital. Infrastructure that has been fulfilled such as access points, printers, and computers, along with their installation. Recruitment of new ICT staff is allocated for system improvement, system maintenance, and troubleshooting. Implementation experience states that organizational support is an important factor in the successful implementation of information systems in healthcare (18).

Technology factors are trouble and improvement handling, easy system interface, and system security. ISOMERIC's trouble and improvement handling is by ICT Unit procedures. After repair, the ICT Unit cannot provide a warranty but provides education and explanation to users on how to use the system and infrastructure that supports the system so that similar problems do not recur quickly. System trouble will hamper the service.

ISOMERIC is a complex new system because of the integration between documents and sections, but with this complexity, the ICT Unit is more challenged to develop this system further, including making improvements. 10% of staff in the ICT Unit are Generation X born between 1965-1981, 20% are Generation Y born between 1982-1999, and 70% are Generation Z born between 2000-2012. Generation Z reacts more quickly to change because they are accustomed to technology and are motivated by challenging work. In addition, Generation Z has a stronger commitment to work than other generations compared to Generation X and Y (21). The display of information systems at Dr Soetomo General Hospital is made as simple and easy as possible, including ISOMERIC. The goal is for users to easily use it and get information from the system. Ease of use and ease of obtaining information affect the implementation of information systems (13,17).

Data and network security influence the availability and integrity of this data, which are the major challenges in the implementation of information systems in healthcare (22). So, the system security needs to be managed properly to overcome this. System security for HIS Dr. Soetomo Hospital is managed by the ICT Unit. System security is made as tight as possible to prevent misuse and data leakage by using passwords for user login, security applications, antivirus, and databases. System security is made to maintain user privacy and maintain data security (17).

The human factor is the acceptance of the user. User training to use ISOMERIC was conducted in February. From this training, users can feel the benefits of using this system, including automated reports, conceptualized activities, easy to verify, real-time documentation, and easy to access the report. In addition, services from the ICT unit that include database security, and trouble and improvement handling can help users to ensure data security and overcome obstacles during implementation. Formal training is necessary before the implementation of information systems to help users understand the steps of using the system (22).

Interestingly, it turns out that the human factor is not only limited to users but also the PIC. The existence of a PIC helps the implementation of the system. This PIC is a bridge between the Tissue Bank as a user and the ICT Unit as a developer. But of course, all problems in this implementation should not be charged to the PIC, management and staff at the Tissue Bank must be active and cooperate so that ISOMERIC can be fully implemented to increase speed and accuracy in the production and service of biomaterial products.

Lesson Learn From Implementation of ISOMERIC

Factors affecting the failure to implement ISOMERIC on time are organizational factors, which include priority implementation and internal problems in tissue banks. The implementation of information systems simultaneously in all units of Dr Soetomo General Hospital made the ICT Unit prioritize implementation. Priority is given to something that has high effective value and high expectations (23). The prioritization of implementation encourages the performance of the ICT Unit to be directed at units that have high effective value and high expectations from patients, such as polyclinic, inpatient, and pharmacy. Internal problems in tissue banks such as no policy about this system and no support from Tissue bank management. Tissue bank management is part-time management. The Leader and coordinator at Tissue Bank are medical doctors, especially surgeons with busy surgery schedules. Medical doctors shall be responsible for medical operations, who can determine which tissues can be collected, define donor screening prescribe technically acceptable means for their processing (23). As a doctor, of course, the main job is to focus on the patient. Patient factors, which potentially indicate social and mental health opportunities, were associated with higher levels of surgeon stress and frustration (24). High levels of stress and a busy operating schedule make surgeons not have enough time to communicate and understand the problems that exist in the tissue bank, including in the implementation of ISOMERIC. Poor communication can cause misperceptions that can lead to wrong decisions. Good and intense communication is an important part of obtaining a better solution (25). By communicating intensely, surgeons can understand the problem as a whole, identify problem priorities appropriately, identify values, manage stressors, and determine the optimal personal work-life balance (26). ISOMERIC implementation is not a priority problem to be solved so there is no evaluation. Evaluation serves to identify challenges and obstacles during the implementation of information systems (27). Time constraints, lack of

communication, and insufficient understanding make management not prepare and support everything for ISOMERIC implementation such as making and socializing policies and encouraging the behavior of their staff to meet new standards. So the implementation of ISOMERIC became late from the plan.

This study also found other factors that made the ISOMERIC implementation fail on schedule, raw material constraints. This is still related to the lack of preparation and support management in the implementation of this system. The raw material handling procedure has been set into ISOMERIC. Only tissues that meet the requirements will be produced. Tissue raw materials are donated materials so they must be utilized as much as possible. All tissue raw materials must meet the requirements before entering the production stage. The requirements are in the form of informed consent documents, informed consent, medical history forms, screening forms, and lab results (HIV, HBsAg, Syphilis, HCV). For tissue raw materials to meet all these requirements, it is necessary to collaborate with other hospitals with the aim that these hospitals complete the requirements. In addition, infrastructure is also needed, freezers to store tissue at the procurement site, so that the tissue is not damaged. Tissue Bank has made purchases of equipment for hospitals, but this storage freezer is not a priority. This cooperation agreement and infrastructure is one of the preparations for the implementation of ISOMERIC. In 2022 it is planned to establish cooperation with other hospitals, but until this study was completed there were only 2 hospitals that collaborated with the tissue bank. Many tissue raw materials do not meet the requirements, so the tissue only stops at the screening stage. Implementation of information systems in hospitals needs to be thoroughly and carefully planned including infrastructure, users, data, and policies (27).

CONCLUSION

ISOMERIC is a unique and complex system, that was implemented to comply with standard APASTB and GMP for biomaterial products. This system aims to ensure the traceability of biomaterial products. Despite a 6 month delay, the ISOMERIC implemented has reached 20% completion, with progress made up to the screening stage.

Organizational factors, including support from the management of Dr. Soetomo General Hospital and infrastructure improvements, have positively influenced ISOMERIC implementation. Technology factors, such as effective trouble handling, system interface, and system security contribute to the system's functionality and reliability. The human factor, including user training, has been addressed through a formal training session, emphasizing the benefit of ISOMERIC and involving PIC to bridge communication between users and developers. Organizational factors, including the prioritization of implementation and internal issues with the Tissue Bank, have contributed to the delay. Lack of policy and support from part-time management at the Tissue Bank, along with poor communication, has hindered the implementation process. Tissue Bank management must provide consistent and continuous support for the implementation of ISOMERIC. This support such as preparing policy, infrastructure, and collaboration with other institutions to provide qualified tissue material. Tissue Bank Management must understand the importance of complying with the new standards and allocate the resources and efforts to meet these standards.

Raw material constraints, stemming from inadequate preparation and support, have impacted the ability to meet requirements and progress beyond the screening stage.

Intensive communication is crucial, especially with medical professionals, to ensure understanding, prioritize implementation, and address challenges effectively. Evaluations should be conducted to identify challenges and obstacles, facilitating better preparation and support for the implementation of ISOMERIC. Collaboration efforts with the hospitals, infrastructure planning, and adherence to established procedures are essential for the successful implementation of ISOMERIC.

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REFERENCES

1. American Association of Tissue Banks. StandardsFor Tissue Banking [Internet]. 14 th edition. United State of America; 2016. (14 th Edition). Available from: http://www.aatb.org/AATB-Standadrs-for-Tissue-Banking
2. Nii T, Katayama Y. Biomaterial-Assisted Regenerative Medicine. Int J Mol Sci. 2021 Aug 12;22(16):8657. https://doi.org/10.3390/ijms22168657
3. Dec P, Modrzejewski A, Pawlik A. Existing and Novel Biomaterials for Bone Tissue Engineering. Int J Mol Sci. 2022 Dec 28;24(1):529. https://doi.org/10.3390/ijms24010529
4. Przekora A. A Concise Review on Tissue Engineered Artificial Skin Grafts for Chronic Wound Treatment: Can We Reconstruct Functional Skin Tissue In Vitro? Cells. 2020 Jul 6;9(7):1622. https://doi.org/10.3390/cells9071622

5. Heri Suroto, Deny M Wiryawan, Camila A Prakoeswa. The Influence of the Preservation method and Gamma irradiation Sterilization on TGF and bFGF Level in Freeze Dried Amnion Membran and Amnion Sponge. Int J Biomater. 2021;2021(6685225). https://doi.org/10.1155/2021/6685225
6. Hilmy N, Yusof N, Nather A, editors. Human amniotic membrane: basic science and clinical application. New Jersey: World Scientific; 2018. 349 p.
7. Farshidfar N, Amiri MA, Jafarpour D, Hamedani S, Niknezhad SV, Tayebi L. The feasibility of injectable PRF (I-PRF) for bone tissue engineering and its application in oral and maxillofacial reconstruction: From bench to chairside. Biomater Adv. 2022 Mar;134:112557. https://doi.org/10.1016/j.msec.2021.112557
8. Baldwin P, Li DJ, Auston DA, Mir HS, Yoon RS, Koval KJ. Autograft, Allograft, and Bone Graft Substitutes: Clinical Evidence and Indications for Use in the Setting of Orthopaedic Trauma Surgery. J Orthop Trauma. 2019 Apr;33(4):203–13. DOI: 10.1097/BOT.0000000000001420
9. Jordan S, Zabukovšek SS, Klančnik IŠ. Document Management System – A Way to Digital Transformation. Na e Gospod Econ. 2022 Jun 1;68(2):43–54. https://doi.org/10.2478/ngoe-2022-0010
10. Ebnehoseini Z, Tabesh H, Deldar K, Mostafavi SM, Tara M. Determining the Hospital Information System (HIS) Success Rate: Development of a New Instrument and Case Study. Open Access Maced J Med Sci. 2019 May 15;7(9):1407–14. doi: 10.3889/oamjms.2019.294
11. Alipour J, Karimi A, Ebrahimi S, Ansari F, Mehdipour Y. Success or failure of hospital information systems of public hospitals affiliated with Zahedan University of Medical Sciences: A cross sectional study in the Southeast of Iran. Int J Med Inf. 2017 Dec;108:49–54. https://doi.org/10.1016/j.ijmedinf.2017.10.005
12. Mohammadpour A, Ghaemi MM, Darrudi R, Sadagheyani HE. Use of Hospital Information System to Improve the Quality of Health Care from Clinical Staff Perspective. Galen Med J. 2021;10:e1830. doi: 10.31661/gmj.v10i0.1830
13. Bogale A. Implementation Status of Health Management Information System in Hospitals of South West Shoa Zone, Oromia, Central Ethiopia. 2021;1–8. https://doi.org/10.2147/CEOR.S288998
14. Sanjuluca THP, de Almeida AA, Cruz-Correia R. Assessing the Use of Hospital Information Systems (HIS) to Support Decision-Making: A Cross-Sectional Study in Public Hospitals in the Huнla Health Region of Southern Angola. Healthc Basel Switz. 2022 Jul 7;10(7):1267. https://doi.org/10.3390/healthcare10071267
15. Hussain R, Ali W, Sohaib M. Perceptions of Physicians Regarding Implementation of Hospital Management Information Systems in a Tertiary Setting Hospital of a Developing Country. Cureus. 2021 Oct;13(10):e18674.
16. Liang MQ, Boudjellab A, Kwon H, Jouvet P, Lebel D, Thibault M, et al. Implementation of a Computerized Provider Order Entry System in a Pediatric Hospital in Canada. Stud Health Technol Inform. 2021 May 27;281:590–4. https://doi.org/10.3233/SHTI210239
17. Nils P, Angelika B, Peter P, Maren L, Fransiska R, Wolfgang H, et al. Evaluation of a Health Information Exchange System for Geriatric Health Care in Rural Areas: Development and Technical Acceptance Study. 2022 Jul;e34568. https://doi.org/10.2196/34568
18. Osvaldić J 1 1 BGH. Information System Implementation in Healthcare: Case Study of Croatia. 2021;114–24. https://doi.org/10.2478/bsrj-2021-0022
19. Sawatsky AP, Ratelle JT, Beckman TJ. Qualitative Research Methods in Medical Education. Anesthesiology. 2019 Jul;131(1):14–22. https://doi.org/10.1097/ALN.0000000000002728
20. Yusof MMohd, Paul RJ, Stergioulas LK. Towards a Framework for Health Information Systems Evaluation. In: Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06) [Internet]. Kauia, HI, USA: IEEE; 2006 [cited 2023 Jan 12]. p. 95a–95a. Available from: http://ieeexplore.ieee.org/document/1579480/ https://doi.org/10.1109/HICSS.2006.491
21. Mahmoud AB, Fuxman L, Mohr I, Reisel WD, Grigoriou N. *" We aren't your reincarnation! "* workplace motivation across X, Y and Z generations. Int J Manpow. 2021 Mar 10;42(1):193–209.
22. Mehrtak M, SeyedAlinaghi S, MohsseniPour M, Noori T, Karimi A, Shamsabadi A, et al. Security challenges and solutions using healthcare cloud computing. J Med Life. 2021;14(4):448–61. https://doi.org/10.25122/jml-2021-0100
23. Asia Pasific Association of Surgical Tissue Banking. Standards for Tissue Banking. Korea; 2016. (Second Edition).
24. Chan HK, Hassali MA, Lim CJ, Saleem F, Ghani NA. Improving pediatric liquid medication labeling of the hospital information system in malaysia: Qualitative analysis of pharmacists' perceptions. Pharm Pract [Internet]. 2016;14(2). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84976407384&doi=10.18549%2fPharmPract.2016.02.699&partnerID=40&md5=6bbba1e0842731ee3f09a0b47689d25c
25. Parker L, Ryan R, Young S, Hill S. Medications and

doctor-patient communication. Aust J Gen Pract. 2021 Oct;50(10):709–14.
26. Balch CM, Shanafelt T. Combating stress and burnout in surgical practice: a review. Adv Surg. 2010;44:29–47. https://doi.org/10.1016/j.yasu.2010.05.018
27. Setyonugroho W, Puspitarini AD, Kirana YC, Ardiansyah M. The complexity of the hospital information system (HIS) and obstacles in implementation: A mini-review. Enferm Clнnica. 2020 Oct 1;30:233–5. https://doi.org/10.1016/j.enfcli.2020.06.053