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# BUSINESS PROCESS IMPROVEMENT OF OUTPATIENT UNIT OF TYPE B PRIVATE GENERAL HOSPITAL IN JAKARTA

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**Abstract:**

Health is one of the factors in economic development and growth. The higher the quality of health, the greater the potential for economic growth and prosperity over the long term. Some important indicators to illustrate the level of health of a country are health expenditure, infant mortality rate, and life expectancy. The average health expenditure of urban residents is higher than that of rural residents. As one of the components of health expenditure, outpatient treatment was identified as one of the largest constituent components, especially for urban areas such as DKI Jakarta Province. Along with the increasing demand for outpatient services in private public hospitals in Jakarta, there is potential of the increasing end-to-end process service quality problems such as queue length and process bottlenecks. The objectives of this study include evaluating the As-Is outpatient service process, analyzing the effectiveness of the outpatient service process against potential queuing problems, analyzing the root of the problem using a Business Process Management approach that uses Business Process Model and Notation (BPMN) and Value Stream Mapping. The results of the analysis on the To-Be process model show that there is potential for time efficiency in the outpatient service process that can improve overall hospital performance.

**Keywords:** Business Process Management; BPMN; VSM; Simulation

## Introduction

Health affects long-term economic growth (Romer, 1986; Mankiw, Romer & Weil, 1992). Affordable and quality health facilities improve welfare (Hartwig, 2010; Husain, 2010);(Gong et al., 2012; Ogundari & Awokuse, 2018). Health supports worker productivity, which in turn increases wages, consumption, and investment, promoting economic growth (Narayan et al., 2010; Zhao & Zhou, 2021). Thus, investments in health support long-term economic growth (Hartwig, 2010).

Health indicators include health expenditure, quality of care, human potential and health, infant mortality, life expectancy, smoking habits, and health services Wang et al., 2018; (Cole, 2019; Kennelly et al., 2020; Marti & Schläpfer, 2014; Ogundari & Awokuse, 2018; Ruhm, 2000; Torre et al., 2019; Vu, 2020; Zhao & Zhou, 2021).

According to Sari (2021), health expenditure, infant mortality, and life expectancy are key indicators to assess a country's health.

The World Health Organization (WHO) defines health expenditure as funds used for health services, family planning, nutrition, and emergency relief, but excludes drinking water and sanitation. In Indonesia, health expenditure increased slowly from 2000 to 2009. However, a significant spike occurred in 2010-2011 and continued to rise until it reached approximately US$160 per capita in 2021, which is equivalent to 3.71% of Gross Domestic Product as seen in Figure 1.


**Figure 1.** Indonesia's Health Expenditure (Per Capita and %PDB) 2000-2021

In 2023, the average monthly health expenditure of the Indonesian population is IDR 31,445, or about 4.24% of total non-food expenditure. However, the proportion of health expenditure is only about 2.17% of total monthly expenditure. Health expenditure generally decreased from 2021 to 2023, because during this COVID-19 pandemic era, social restrictions were in place that made individuals focus more on maintaining health. Regionally, monthly health expenditure in urban areas tends to be higher, despite a decrease of 13.09% from 2021 to 2023, while in rural areas there is an increase of 2.14% as can be seen in Figure 2.

Outpatient treatment is one of the major components of health expenditure, especially in urban areas such as DKI Jakarta (Susenas, 2022). In DKI Jakarta Province, approximately 47.96% of the population reported seeking outpatient care according to data from the National Socio-Economic Survey (Susenas) in 2022. This data shows that more female residents (48.1%) than male residents (47.81%) sought outpatient care as can be seen in Table 1.

Furthermore, data by district shows that West Jakarta City had the highest percentage with 62.78%, with the proportion of female residents at 61.68% and male residents at 64.04%. Meanwhile, Kepulauan Seribu has the lowest percentage at 11.09%, with a proportion of female population of 13.02% and male population of 8.94% (Susenas, 2022).

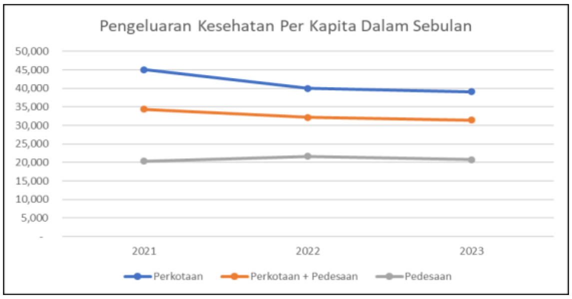


**Figure 2.** Indonesia Monthly Health Expenditure Per Capita 2021-2023

**Table 1. Percentage of Population with Health Complaints and Outpatient Treatment in the Last Month by District/City and Gender 2022**

| *Regency/City* | | *Male* | *Fem ale* | *Male + Female* |
|---|---|---|---|---|
| (1) | | (2) | (3) | (4) |
| 1 | Thousand Islands | 8.94 | 13. 02 | 11.09 |
| 2 | South Jakarta | 40.99 | 44. 07 | 42.66 |
| 3 | East Jakarta | 45.69 | 43. 05 | 44.36 |
| 4 | Central Jakarta | 39.3 | 41. 29 | 40.39 |
| 5 | West Jakarta | 64.04 | 61. 68 | 62.78 |
| 6 | North Jakarta | 35.25 | 41. 32 | 38.55 |
| | **DKI Jakarta** | **47.8 1** | **48.1** | **47.96** |

The number of health facilities in DKI Jakarta Province increased from 2018 to 2021. The number of government hospitals increased from 47 to 50, military/police hospitals from 11 to 12, and private hospitals from 130 to 133. In total, the number of health facilities increased from 189 to 194 (Susenas, 2022). The addition of health facilities, especially private hospitals, plays an important role in providing care when residents experience health problems.

The quality of hospital services needs to be improved to meet patient expectations. One way to improve quality is to speed up patient care. Patient waiting times can be longer due to the limited number of doctors, especially in Indonesia which has fewer doctors compared to neighboring countries such as Malaysia and Singapore.

Long queues occur especially in public hospitals on Java Island, especially in Jakarta, where patients have even queued since 05.00 WIB (Indonesian Ministry of Health & Central Bureau of Statistics, 2014).

The improvement of business processes in the outpatient unit of a type B private hospital in Jakarta aims to enhance service efficiency through process mapping, root cause analysis, and alternative scenario simulations. Utilizing Business Process Model and Notation (BPMN), Value Stream Mapping (VSM), and Arena simulation software, this study primarily focuses on reducing waiting times in the pharmacy's drug retrieval process by implementing alternative scenarios with additional resources, achieving significant reductions in service time. Further research could explore related areas, such as implementing digital technology in hospitals to enhance patient satisfaction and efficiency, analyzing how business process improvements affect patient satisfaction in outpatient services, or assessing cost savings from process efficiency improvements and their impact on hospital performance. Adapting similar studies with methodologies that integrate business process analysis, simulation, and a focus on patient service efficiency could provide valuable insights into healthcare management.

Multi-discipline outpatient clinics (MDOCs) in hospitals require good organization due to their complex structure. Although MDOCs can improve comprehensive care, managing such units is a difficult task (Aissaoui et al., 2024). The main challenges include timely provision of care, complex appointment arrangements, and process efficiency. To improve efficiency, a systematic approach and systemic improvements are needed. Tools such as Value Stream Mapping (VSM) and Business Process Model and Notation (BPMN) can help identify problems, but adaptations are needed for complex situations such as MDOC (Batubara et al., 2020).

This research aims to improve processes and address inefficiencies in MDOC through a holistic approach to the Patient Care Delivery Process (PCDP). Therefore, a case study was conducted at a type B private general hospital in Jakarta to obtain an overview of the implementation of business process improvements based on field data. This hospital is often used as a referral for new patients and is equipped with expert health workers and advanced medical equipment. It is expected that the results of this study can be a suggestion for stakeholders in companies engaged in the hospital industry sector.

## Method

The research was conducted using a descriptive quantitative method using a case study approach at the outpatient unit of a type B private general hospital in Jakarta.

The research flow in more detail can be seen in Table 4, where the research starts from the problem formulation stage. In this stage, the research will focus on finding data related to Outpatient Unit services such as finding the specialist clinics with the highest number of patients and on which days the related specialist clinic services are busiest. The researcher needs the involvement of hospital staff in interviews and discussions to obtain such data.

In the second stage, namely data and information collection, researchers will collect primary and secondary data needed in the research. Primary data such as the duration of each service, the length of waiting time will be recorded during the observation. The recording method uses a time recording sheet that has been designed by the researcher and will involve hospital staff in recording the start time and completion time of each related service. Meanwhile, the secondary data such as the existing business processes and service flows, historical data on the number of patients and so on were collected by researchers through interviews with hospital staff and internet searches.

Data collection is done by direct observation and recording in the field. The author will observe the flow of patient services at an internal medicine specialist clinic, which is the busiest clinic in the outpatient unit, starting from the registration process until the completion of the process and the patient is allowed to leave the hospital. The recording process is carried out in every process taken by a patient who chooses the patient service flow of the object of research. Recording is done using a special recording form where the parameters recorded include service time and waiting time for each process. The special recording form is the author's preparation and is attached as an appendix.

The population in this study is the number of patients registered at the internal medicine specialist service line on the selected observation day (April 20$^{th}$, 2024). Meanwhile, the sample size in this study is the number of patients registered during the observation conducted between 08:00 and 16:00 local time.

The choice of observation day falls on Saturday because based on the results of interviews with registration officers and data retrieval from the hospital's digital archives, weekends are the days with the highest number of patient visits each week so it is considered to have the highest potential for the emergence of a buildup of service queues. The number of outpatient unit visits up to 30 days before the observation day showing that visits on Saturdays always occupied the highest position.

The only exception occurs in Week IV, exactly on April 13, 2024, where the number of visits on Saturday is not the highest in the current week. This was due to the fact that the date was still within the national leave period for Eid al-Fitr 2024, which seems to have affected the number of patient visits in the outpatient unit of the research hospital. As a side note, there are several days with no outpatient visits at all, such as in Week II and Week IV, all of which are national holidays, precisely on Friday (March 29, 2024), Wednesday (April 10, 2024) and Thursday (April 11, 2024) where outpatient services at the research hospital are closed.

After all the data was obtained, the first data processing process began by mapping the As-Is business process, followed by problem analysis and root cause analysis as well as time and cost impact analysis (if possible). The methods used in this data processing are the BPMN (Business Process Model Notation) approach, VSM (Value Stream Mapping) and Queuing Theory.

Furthermore, in the second data processing process, researchers will conduct future state mapping, design To-Be business processes, conduct process simulations, and analyze the impact of time and cost. Specifically for the queue process simulation, the Arena Simulation Software Version 16.20.00 will be used while Bizagi software will be used for the overall business process simulation.

In order to reduce cycle times associated with queuing problems in the Designing To-Be Process, queue modeling simulations will be carried out using Arena software. The simulation process begins with data collection accompanied by model formulation, then testing the validity of model assumptions, creating a simulation model program, testing the validity of the model program, modeling alternative scenarios and production runs. The stages of the simulation process can be seen in more detail in Figure 3.

Simulation model development will be carried out by translating the previously formulated model concept through a simulation program in Arena Simulation Software Version 16.20.00. In this study, the model built is only for the process that has the largest NVA in VSM where the total time spent by patients in the process is used as a measure of system performance.

After building a simulation model, the next step that will be carried out is a sensitivity test of the model that has been built by statistically comparing the model output to actual field data. The statistical approach that will be carried out is the paired t-test with a confidence level of 95%. The model can be said to be valid and considered to describe the actual system if the average data from the pilot runs of the model is within the confidence interval. Finally, a model that has passed the paired t-test sensitivity test can be considered as a base scenario model.

Modeling alternative scenarios is done by applying several experiments to the basic scenario model. For sure, the choices of alternative scenarios that will be used as experiments are only those that have been filtered through the results of interviews with related service units and staff who have been appointed by the hospital as research assistants. In this research, the proposed alternative scenario that will be developed is the optimization of the number of servers of a service to get a shorter service time / Length of Stay (LOS).

After the alternative scenario model has been determined, Production Runs will be carried out with predetermined parameters such as the length of replication for 1 day which is equivalent to 8 hours and the number of replications 30 times.

Finally, the simulation results of the alternative scenario model that have been obtained will then be compared with the base scenario model using the paired t-test statistical method. This method is basically used to determine whether there is a significant average difference between two related populations (Levine, 2020). In the context of simulation, this is meant for the comparison of the results of the alternative scenario with the baseline scenario that can be tested through the calculation of confidence intervals. If a zero value is not found in the confidence interval, then the simulation results of the base scenario model are statistically significantly different from the simulation results of the alternative scenario model, thus rejecting $H_0$. However, if there is a zero value in the confidence interval, then the simulation results of the base scenario model are not statistically significantly different and thus fail to reject $H_0$.

In the final stage, this research will provide recommendations for methods that can be used to measure the success of business processes (To-Be) and maintain the improvement of business process performance when later implemented in the field.

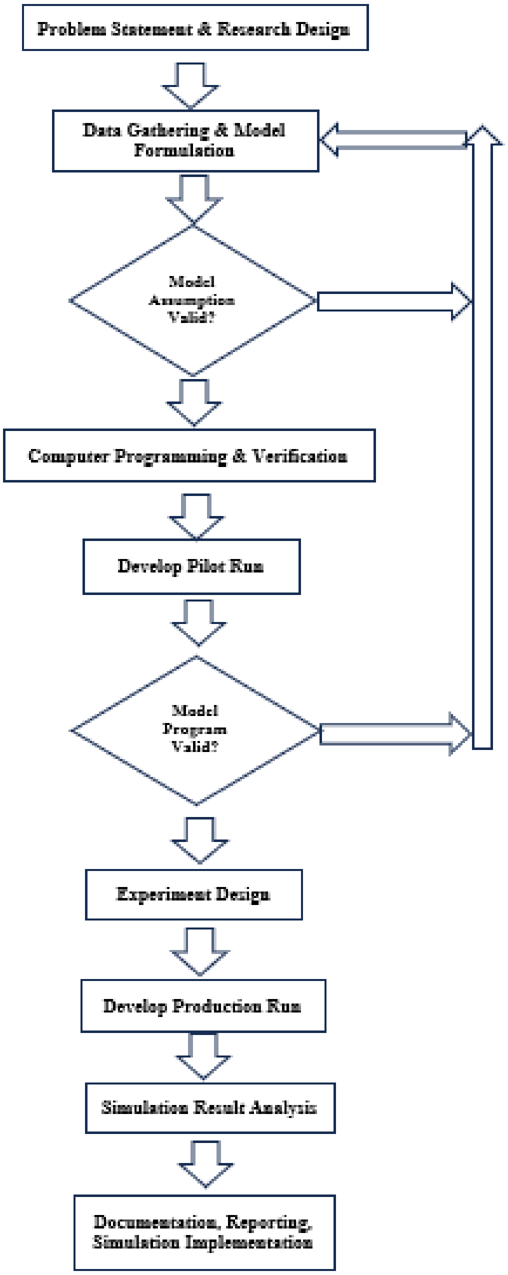


**Figure 3.** Simulation Process Stages

**Table 2. Research Flow**

| No | Stages | Research Working Plan | fgtr | Hospital Staff Involvement | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Yes/ No | Activity Type | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Problem Formulation | a | b. Identification of Outpatient Unit services with the highest number of patients.<br>c. Identify the service days with the highest number of patients. | Interviews and discussions with research hospital staff. | Yes | Interviews, Discussions | - |
| 2 | Data & Information Collection | a | b. Primary data collection: duration and waiting time for each service. | Time recording directly in the field using a time recording sheet. | Yes | Recording service time on the time recording sheet | Primary data collection was carried out for 1 day (8 working hours) |
| | | c | d. Secondary data collection such as: existing business process, existing service flow, historical number of patients, previous research data (if any), etc. | Internet searches, interviews with research hospital staff. | Yes | Interviews, Discussions | |
| 3. | Data Processing 1 | | a. Mapping and analyzing existing business processes (patient service flow) As-Is Process.<br>b. Conduct problem analysis (bottleneck, queuing).<br>c. Conduct | BPMN (Business Process Model Notation), VSM (Value Stream Mapping), Queuing Theory. | No | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Root Cause Analysis<br>d. Conduct an impact analysis on time, resources and also (if possible) cost | | | | |
| 4. | Data Processing 2 | a. Conduct future state mapping<br>b. To-Be Process Planning<br>c. Simulation of To-Be Process | BPMN, VSM, Discrete Time System Analysis with Arena and Bizagi. | No | - | - |
| 5 | Discussion of Research Results | a. Comparing As-Is Process to To-Be Process<br>b. Analyze the impact of time, resources and also (if possible) costs on the To-Be Process | T-Paired test to ensure the significance of To-Be Process, Bizagi modeling. | No | - | - |
| 6 | Summary & Recommendations | Summarize the research results and formulate related suggestions. | - | No | - | - |

## Results and Discussion

Hospital X is a type B private general hospital in Jakarta. The hospital is located on one of the main roads in the center of Indonesia's capital city, Jakarta. It is located on one of the main roads in Central Jakarta and directly opposite Dr. Cipto Mangunkusomo General Hospital. The strategic location makes Hospital X easily accessible from various parts of Jakarta, both through public transportation and private vehicles.

Hospital X has a spacious and modern building with an area of 51,240 m2 on a land area of 47,820 m2. The building facilities include inpatient rooms, outpatient rooms, emergency units, operating rooms, laboratories, pharmacies, and various other supporting facilities with total 252 bed units.

This health facility is also supported by professional and trained medical personnel, including specialists who are experienced in various fields such as surgery, cardiology, neurology, oncology, and others. There are 33 General Practitioners, 7 Dentists, 29 Basic Specialists, 14 Support Specialists, 39 Other Specialists, 8 Surgical Subspecialists, 1 Pediatric Surgical Subspecialist, 5 Internal Medicine Subspecialists, 1 Heart and Vascular Specialist, Dental and Oral Specialist 8 people, Pharmacy 22 people, Nursing 57 people, Medical Technician 2 people, Midwifery 1 person, Nutrition Services 10 people, Laboratory 2 people, Physical Therapy 9 people, Biomedical Engineering 12 people, Medical Technician 12 people, and Environmental Health 1 person.

The hospital provides integrated services that include routine health checks, emergency case management, inpatient services, rehabilitation, and other health services. Supported by supporting facilities such as a cafeteria, a comfortable waiting room, and a large parking area, as well as a commitment to provide friendly, empathetic, and high-quality services to every patient who comes, the Research Hospital is one of the main referral health facilities in Jakarta.

## Results

The results of the interview show that the business model of the operation of hospital X consists of Management Process, Core Process and Support Process. Within the Core Process itself there are business process activities consisting of Inpatient Services, Outpatient Services, Emergency Services and Patient Based Care Services as can be seen from Figure 4.

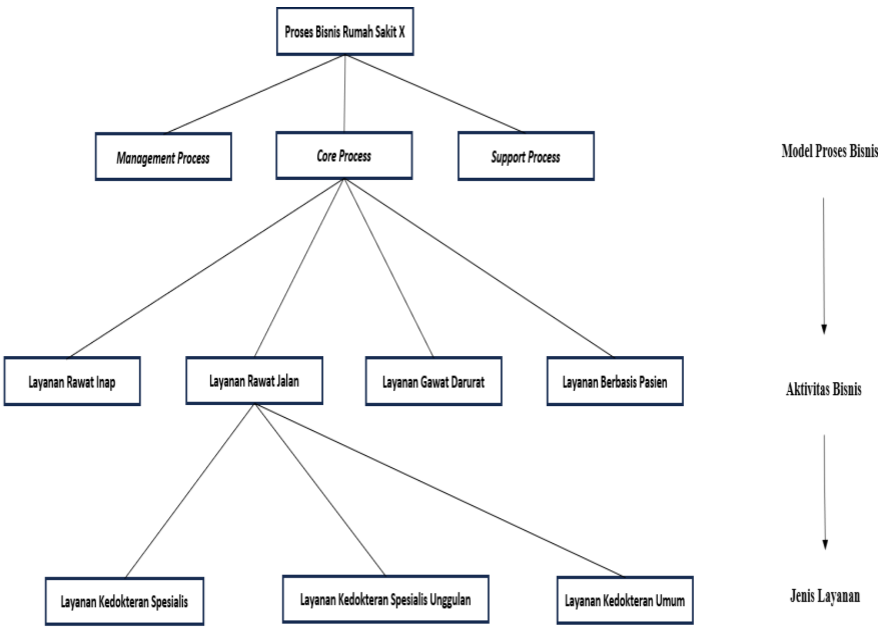


**Figure 4.** Hospital Structure

A process architecture model whose scope includes processes at Level 1 is known as a process landscape model or more simply Level 1 process architecture (Dumas et al., 2018). Furthermore, it is said that each element in the process landscape model shows one or more detailed business processes of Level 2 processes. Meanwhile, the Level 2 hospital X business processes included in the Management Process include Strategic Planning, Risk Management, Quality & Compliance Management and Innovation Management. Meanwhile, the Support Process consists of Finance, Human Resource, Procurement & General Affair Management and IT Infrastructure & Services.

While all business process activities (Inpatient Services, Outpatient Services, Emergency Services and Patient-Based Care Services) that are part of the Core Business of Hospital X consist of the Plan, Execution, Monitoring and Customer Feedback stages as shown in Figure 5.

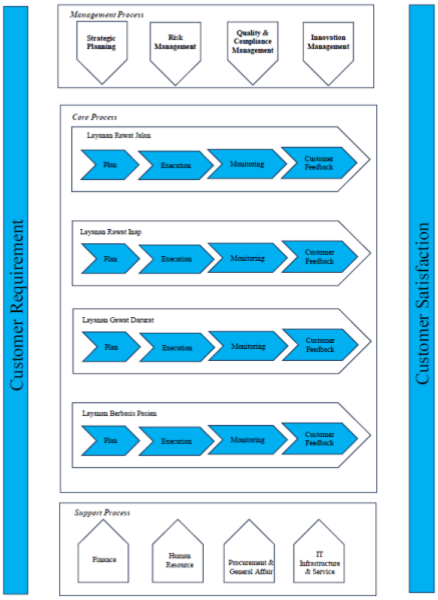


**Figure 5.** Landscape Process Hospital X

Based on the results of interviews and discussions with authorized hospital staff, a further description of the actual As-Is business process was obtained which then the process flow was reassembled using the BPMN method as can be seen in Figure 6.

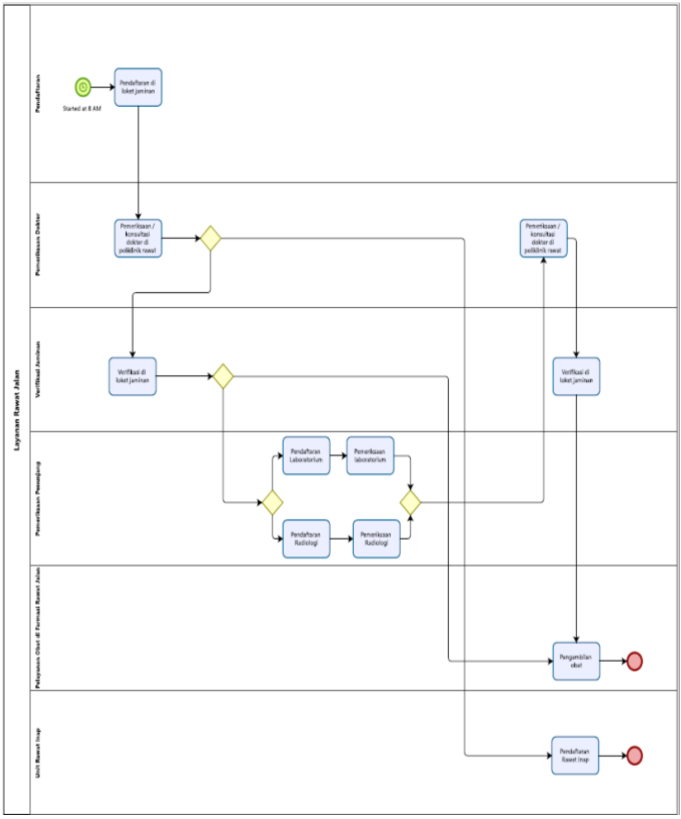

**Figure 6.** Business Process of Specialist Internal Medicine Clinic

In general, the business process of the research subject consists of 1 pool (internal medicine specialist clinic), 6 swim lanes (registration, doctor examination, guarantee verification, supporting examination, pharmaceutical services, inpatient unit). As-Is business process consists of 1 start event, 11 tasks, 4 exclusive gateways, and 2 end events.

Referring to the As-Is business process that has been modeled with Bizagi Modeler, a Value Stream Mapping analysis is carried out where each existing business process activity will be grouped based on the added value that the activity has to the patient. Any activity that adds value directly to the patient is classified as Value Added (VA) while activities that do not add value to the patient are classified as Non-Value Added (NVA).

VSM analysis in this study is divided into 3 parts, namely: patient flow without supporting examination, patient flow with laboratory examination, patient flow with radiology examination. Patient flow without supporting examinations, as shown in Figure 7, has a Lead Time of 162 minutes with a total Value Added of 22 minutes or (14% of Lead Time) Meanwhile, patient flow with laboratory examinations, as shown in Figure 8, has a Lead Time of 202 minutes with a total Value Added of 35 minutes (17% of Lead Time). Finally, the flow of patients with radiology examinations, as shown in Figure 9 has a Lead Time of 205 minutes with a total Value Added of 38 minutes (19% of Lead Time).

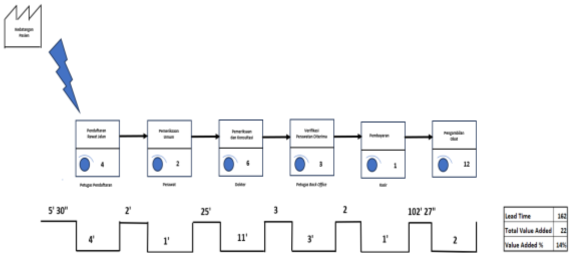

**Figure 7.** Value Stream Mapping of Patients Without Supporting Examination

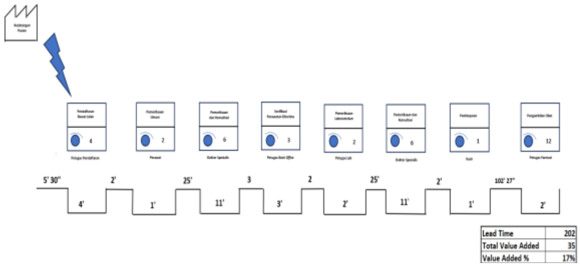

**Figure 8.** Value Stream Mapping of Patients Without Supporting Examination

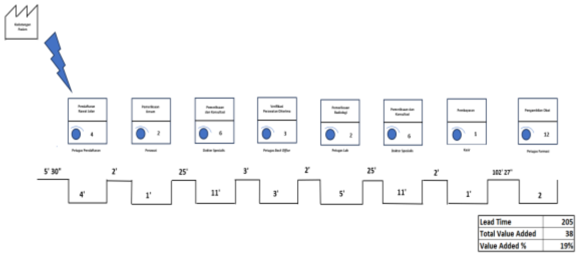

**Figure 9.** Value Stream Mapping of Patients with Laboratory Testing

It can be seen in Figure 7 to Figure 9 that the largest Non-Value Added is always in the drug taking activity for 102 minutes 27 seconds which is the average length of drug taking recorded during field observations. Based on this VSM analysis, the drug taking process can be said to be the process that has the longest LOS (Length of Stay) and almost all the time used is NVA so that this process activity will be chosen as the main target of improvement.

As to have process improvements, a series of developments were carried out on the As-Is process model with the ESIA method approach (Eliminate, Simplify, Integrate, Automate). However, based on direct observation in the field and As-Is Process analysis, the business processes in the research hospital can be said to be quite lean, simple, and already involve quite a lot of digitization and automation. It is also evident from the VSM analysis that only the process of taking medicine and examining doctors has a long waiting time while others can be said to be fast enough so that the design of the To-Be Process with the ESIA method approach is undone.

Based on the data collected both through direct observation and interviews, the entity flow in the pharmacy section can be made with simple assumptions in the form of a flow chart as can be seen in Figure 10.

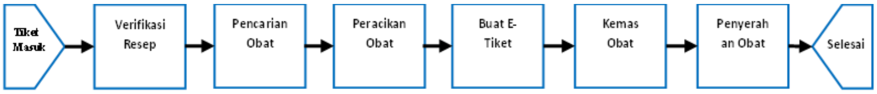


**Figure 10.** Simplified Assumptions of the Operational Model of Pharmacy Services

The simple assumption model in Figure 10 was then transformed into a base scenario model in the form of a process module of the Arena® simulation program as shown in Figure 11.

Then, after passing the verification process, the base scenario model needs to be validated where a comparison will be made between the total average time (Length of Stay/LOS) of real data and simulated data from entities (in this case, drug manufacturing request tickets) that enter the drug retrieval process activity.

The amount of real data obtained from the management information system of the research hospital on the same day is 214 ticket. The average total LOS of each entity is 105.7 minutes. Meanwhile, in the scenario simulation model with 30 repetitions, the average total LOS of each entity is 102.3 minutes.

To test the validity of the base scenario model results, the presence of real data in the confidence interval is checked. If real data is found within the confidence interval of the base scenario model results, then the base scenario model can be said to be valid. First of all, by using a confidence interval of 95% ($\alpha$ = 5%) and a degree of freedom (df) of 29, a critical t of 2.0452 is obtained. After that, the value of the confidence interval for each type of drug taking process (Mixed/Compounding/Packaged) can be calculated.

From the calculation, the average upper tail value is 108.9 minutes and the lower tail value is 95.6 minutes so that the confidence interval of the basic scenario model becomes $95.6 < \mu < 108.9$. Meanwhile, from the real data in Appendix 31, it is known that the average LOS of the drug manufacturing request ticket entity is 105.7 minutes. Finally, since the real data LOS entity falls within the confidence interval of the base scenario model results, it can be said that the base scenario model is valid.

Referring to the average time of each process module in the base scenario model in Table 4.6, it can be seen that the creating compounding medicine module has the highest LOS entity of 103.7 minutes followed by the weighing compounding medicine module of 13.9 minutes. Therefore, in alternative scenario 1, 1 additional resource will be added to the creating compounding medicine module.

In the Arena® program, the addition of 1 resource can be done by changing the resource description on

compounding staff from 1 to 2 as can be seen in Appendix 32. In other modules, no changes are applied and the number of replications remains the same, namely 30 times.

Based on the simulation results summarized in Table 5, it can be seen that for the type of mixed medicine, alternative scenario 1 significantly reduces LOS, from 143.7 minutes to 89 minutes. This is also confirmed by the paired t-test which states that the

LOS confidence interval for Mixed Medicine does not contain a value of 0 because 45.0 < μ < 64.5.

Likewise, the simulation results are summarized in Table 6, where it is known that for the type of compounding medicine, alternative scenario 1 significantly reduces LOS, from 138.9 minutes to 85.1 minutes. This is also confirmed by the paired t-test which states that the confidence interval of LOS for compounded medicine does not contain a value of 0 because 42.4 < μ < 65.1.

Another case with the simulation results summarized in Table 7, where it is known that for the type of packaged medicine, alternative scenario 1 does not pass the paired t-test since the confidence interval contains a value of 0 because -53.54 < μ < 4.16. This happens because the changes made by scenario 1 simulation, namely the addition of resources for the compounding module, are not in the Packaged Medicine retrieval process flow, but only in the Mixed Medicine and Compounding Medicine retrieval process flow.

**Table 3. Summary of Alternative Scenario 1 Results (Mixed Medicine)**

| Mixed Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 89.0 |
| Paired difference population mean ($\bar{D}$) | 54.8 |
| Standard Deviation ($S_D$) | 26.1 |
| $t_{STAT}$ | 11.5 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 64.5 |
| *Lower Critical Value* | 45.0 |
| *Confidence Interval* | 45.0 < μ < 64.5 |

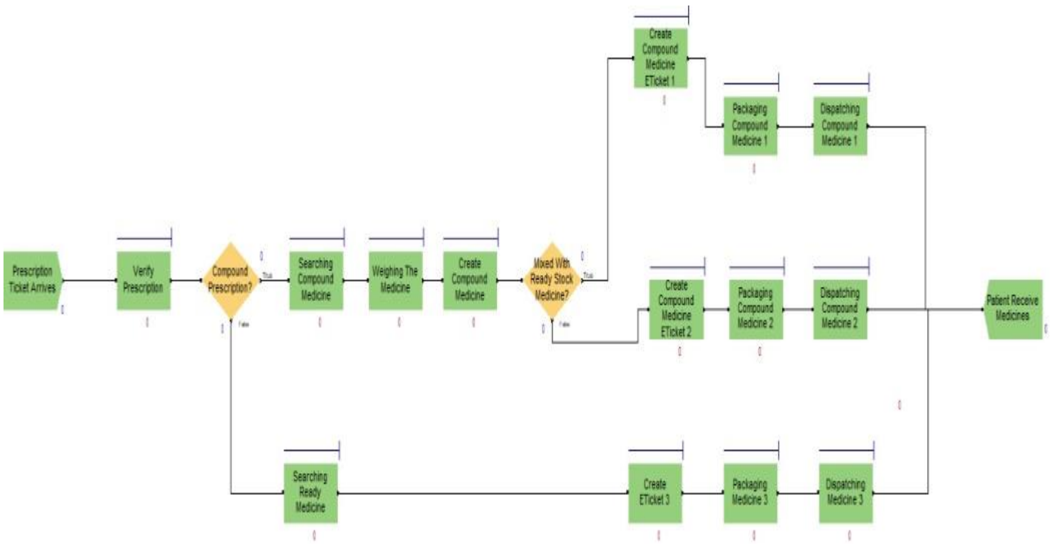


**Figure 11.** Base Scenario Simulation Model

**Table 4. Summary of Alternative Scenario 1 Results (Compounding Medicine)**

| Compounding Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 85.1 |
| Paired difference population mean ($\bar{D}$) | 53.7 |
| Standard Deviation ($S_D$) | 30.3 |
| $t_{STAT}$ | 9.7 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 65.1 |
| *Lower Critical Value* | 42.4 |
| *Confidence Interval* | $42.4 < \mu < 65.1$ |

**Table 5. Summary of Alternative Scenario 1 Results (Packaged Medicine)**

| Packaged Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 48.5 |
| Paired difference population mean ($\bar{D}$) | -24.7 |
| Standard Deviation ($S_D$) | 77.3 |
| $t_{STAT}$ | -1.8 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 4.16 |
| *Lower Critical Value* | -53.54 |
| *Confidence Interval* | $-53.54 < \mu < 4.16$ |

To see whether the process flow of taking packaged medicine can still be improved, an alternative scenario 2 simulation is prepared where in addition to an additional 1 compounding staff, there is also an additional 1 packaging staff in the process flow of taking packaged medicine.

In the Arena® program, adding the number of resources by 1 officer can be done by changing the resource description of compounding staff from what was originally written as 1 to 2. In other modules, no changes were applied and the number of replications remained the same, namely 30 times.

Based on the simulation results summarized in Table 8, it can be seen that for the type of mixed medicine, alternative scenario 2 significantly reduces LOS, from 143.7 minutes to 62 minutes. This is also confirmed by the paired t-test which states that the LOS confidence interval for Mixed Medicine does not contain a value of 0 because $70.6 < \mu < 92.6$.

Likewise, the simulation results are summarized in Table 9, where it is known that for the type of compounding medicine, alternative scenario 2 significantly reduces LOS, from 138.9 minutes to 58.5 minutes. This is also confirmed by the paired t-test which states that the confidence interval of LOS for Compounding Medicine does not contain a value of 0 because $68.8 < \mu < 91.9$

Another case with the simulation results summarized in Table 10, where it is known that for the type of packaged medicine, alternative scenario 2 does not pass the paired t-test since the confidence interval contains a value of 0 because $-31.21 < \mu < 31.06$. This can be interpreted that the simulation considers that no significant changes will occur in the flow of packaged medicine even if one packaging staff is added.

## Discussion

The alternative scenario 1 model shows several improvements including a decrease in the LOS of the Mixed Medicine retrieval process and also the LOS of the Compounding Staff retrieval process, which was originally 143.7 to 89 minutes and 138.9 to 85.1 minutes, respectively. In other words, alternative scenario 1 succeeded in reducing the LOS of the mixed medicine and compounding process by 38% and 37%, respectively.

Meanwhile, the alternative scenario model 2 also shows some improvements, including a decrease in the LOS of the Mixed Medicine retrieval process and also the LOS of the Compounding Staff retrieval process, which originally went from 143.7 to 62 minutes and 138.9 to 58.5 minutes, respectively. In other words, alternative scenario 2 succeeded in reducing the LOS of the mixed medicine and compounding process by 57% and 56%, respectively. Meanwhile, in both the alternative scenario 1 and alternative scenario 2 simulation models, there was no significant impact on the packaged medicine retrieval process.

After the business process model (To-Be) is determined, it is necessary to identify what factors must be anticipated in order to create a sustainable process. Based on interviews conducted with expert staff at the research hospital, it was found that the discipline factor still needs to be improved, especially the time discipline of specialists practicing in the Outpatient Unitand also the standardization of compounding medicine equipment.

**Table 6. Summary of Alternative Scenario 2 Results (Mixed Medicine)**

| Mixed Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 62.0 |
| Paired difference population mean ($\bar{D}$) | 81.63 |
| Standard Deviation ($S_D$) | 29.5 |
| $t_{STAT}$ | 15,4 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 92.6 |
| *Lower Critical Value* | 70.6 |
| *Confidence Interval* | $70.6 < \mu < 92.6$ |

**Table 7. Summary of Alternative Scenario 2 Results (Compounding Medicine)**

| Compounding Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 58.5 |
| Paired difference population mean ($\bar{D}$) | 80.4 |
| Standard Deviation ($S_D$) | 30.8 |
| $t_{STAT}$ | 14.2 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 91.9 |
| *Lower Critical Value* | 68.8 |
| *Confidence Interval* | $68.8 < \mu < 91.9$ |

**Table 8. Summary of Alternative Scenario 2 Results (Packaged Medicine)**

| Packaged Medicine | |
|---|---|
| Population Mean of Scenario 1 ($\bar{x}$) | 24.2 |
| Paired difference population mean ($\bar{D}$) | -0.08 |
| Standard Deviation ($S_D$) | 83.3 |
| $t_{STAT}$ | -0.005 |
| *t-critical (α = 5%, df =29)* | 2.0452 |
| *Upper Critical Value* | 31.06 |
| *Lower Critical Value* | -31.21 |
| *Confidence Interval* | $-31.21 < \mu < 31.06$ |

## Conclusion

The outpatient unit in the research hospital benefits significantly from automation, especially in registration, enhancing service effectiveness. However, Value Stream Mapping (VSM) of the internal medicine outpatient flow identified the drug-taking process as the largest Non-Value-Added activity. Using discrete event simulation with Arena® software, the compounding process was found to be a bottleneck. Simulation results revealed that adding one compounding staff member (Alternative Scenario 1) could reduce patient Length of Stay (LOS) by 37-38% for compounding and mixed medicine, though no significant improvements were observed for finished medicine. Recommendations include optimizing specialist doctors' schedules, integrating the Hospital Information Management System across units, redesigning the pharmacy layout, increasing compounding staff, and standardizing tools to enhance efficiency. Additional suggestions involve staff training, real-time monitoring, improved patient communication systems, and incorporating cost-analysis frameworks in future research to balance time and financial impact. These measures aim to holistically optimize hospital workflows, leveraging technology to improve both service quality and operational efficiency.

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