

Proposal Design for Improving the Treatment Room of Adiva Husada Primary Clinic to Enhance the Comfort of Pediatric Patients Using a Human-Centered Design Approach with the Double Diamond Method

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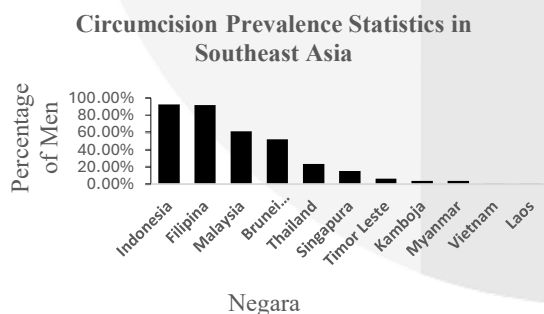
This research aims to design improvement proposals for the Action Room at Adiva Husada Primary Clinic using a Human Centered Design approach and the Double Diamond Diagram method. The main issue identified is the limited facilities in the Action Room, which affect patient comfort, especially children, during medical procedures. This research uses qualitative methods with data collection through interviews, observations, and technical measurements (lighting, temperature, air, and sound). The research results indicate that the Operating Room needs improvements in terms of ergonomics and comfort, including inadequate lighting, poor temperature and air circulation, as well as disturbing noise. Based on these findings, the improvement plan was formulated by considering health standards and user anthropometry. This design is expected to improve comfort and meet the needs of patients, as well as serve as a reference for the improvement of the Procedure Room in other clinics. The implementation of this improvement plan requires further evaluation and consideration of the limited resources available at the clinic.

Keywords— Human Centered Design, Double Diamond Diagram, Ergonomics, Action Space, Clinic..

I. INTRODUCTION

Child welfare is a system of life and livelihood for children that can ensure their growth and development in a proper manner, both spiritually, physically, and socially. Child Welfare Efforts consist of efforts in guidance, development, prevention, and rehabilitation. [1].

Figure 1 Statistics on male circumcision



(Source: Pop Health Metrics [2] dari goodstats.id)

In the Law, Article 1 Paragraph 2 also states that a Child is the next generation who has not yet reached the age of 21. This serves as the basis that the health of children needs to be considered in efforts to promote child welfare.

Child Health Efforts are activities carried out in a coordinated, integrated, and continuous manner to improve the health status of children in the form of disease prevention, treatment, and health recovery by the Government, local governments, and/or the community [3]. In an effort to provide significant health benefits for children, circumcision is one of the measures.

Figure 1 shows the statistics on boys in Southeast Asia. Indonesia is the country with the highest prevalence rate at 92.5%, while the Philippines and Malaysia have the second and third highest circumcision prevalence rates after Indonesia, with rates of 91.7% and 91.7%, respectively. This is driven by cultural and religious influences.

The main common issue is the very limited clinic area, and the Procedure Room has become a space with dual functions. This was mentioned in the initial interview during the observation of patients, nurses, and operational doctors. Subsequent observations were conducted using a Lux Meter, Air Quality Detector, and Sound Level Master to understand the ergonomic aspects in the action room. From this issue, it is necessary to improve the Action Room to meet standards so that it is more efficient and comfortable for patients, especially pediatric patients.

The purpose of this research is to provide a Proposed Improvement Design as a solution using a Human Centered Design (HCD) approach. The proposed solution is expected to enhance the comfort of the action room and meet the needs of patients, so it can be implemented for further improvements at Adiva Husada Clinic.

Human Centered Design contributes to the realization of investment goals in the health sector: improving public health and enhancing the performance of the health system [4]. By using the Human Centered Design approach, the proposed solutions are expected to improve the comfort of the action space and meet patient needs, making them implementable for improvements in other clinics.

II. THEORETICAL STUDY

A. Adiva Husada Clinic

Klinik merupakan fasilitas kesehatan yang menyelenggarakan pelayanan medis, berupa medis dasar dan/atau medis spesialis secara komprehensif [4]. Klinik berkewajiban untuk memberikan pelayanan yang aman, berkualitas, mengutamakan kepentingan pasien sesuai standar profesi, standar pelayanan dan standar operasional [4].

B. Human Centered Design

Human Centered Design is an approach in development through interactive systems aimed at creating designs that are usable and useful with a focus on users, their needs and requirements, and applying knowledge and techniques of human factors/ergonomics, and usability. [4]. Human Centered Design is a design that serves as a reference in a planning or design process.

C. Double Diamond Diagram

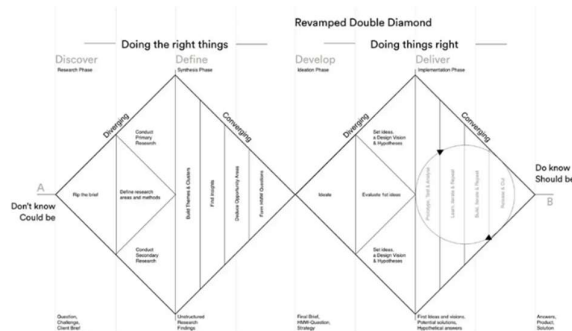


Figure 2 Double Diamond Framework
(Source: Design Council [5])

Double Diamond Diagram is a design model used to solve problems and create innovative solutions in a structured manner [6]. This design model is a framework that aligns with the phases of Human Centered Design, adapted into the framework of Problem Space and Solution Space.

D. Ergonomics

Ergonomi berasal dari kata Yunani 'ergon' (kerja) dan 'nomos' (aturan) yang secara keseluruhan berarti aturan yang berkaitan dengan kerja, ergonomi adalah ilmu multidisipliner yang bertujuan mengoptimalkan sistem manusia pekerjaannya agar tercapai alat, cara, dan lingkungan kerja yang efektif, sehat, aman, nyaman, dan efisien [7].

E. Anthropometry

Anthropometry comes from the Latin language, namely 'anthropos' which means human and 'metron' which means measurement [8]. Anthropometry as the measurement of body dimensions or other physical characteristics of the body that corresponds to the design of something that will be worn by humans [9]. Anthropometry is used as a study of human body dimensions [10]. Simply put, Anthropometry is the measurement of the human body [11].

F. Prototyping

Prototyping is an iterative process that facilitates an exploratory approach to design, allowing designers to test hypotheses, uncover user needs, refine functionality, and reduce risks early in the development process [12]. In this research, prototyping is a very important part and must be carried out carefully so that designers can reduce the risk of errors and failures in both physical and non-physical products.[13].

III. METHOD

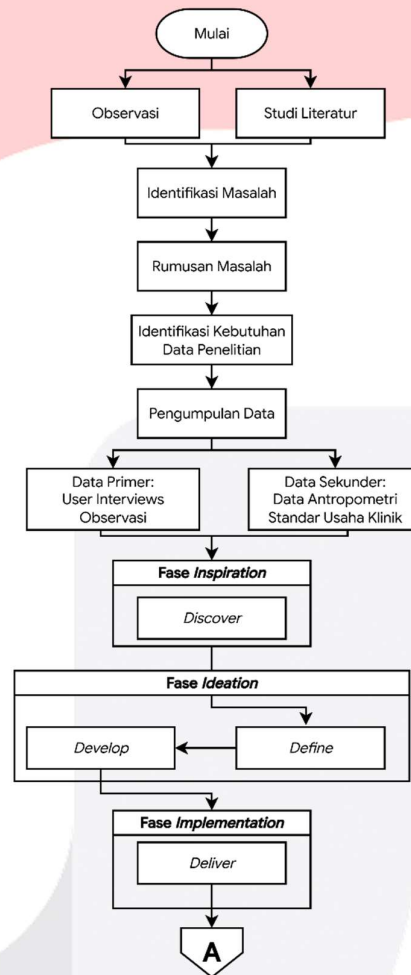


Figure 3 Research Systematics

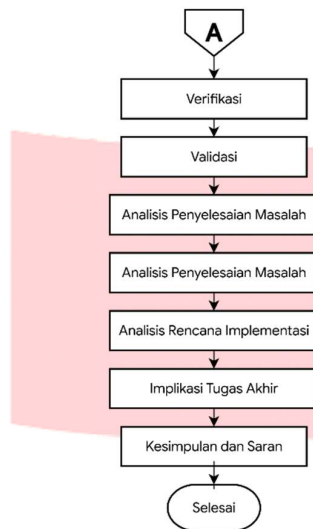


Figure 4 Research Systematics (continued)

B. Data Gathering

Data collection begins with identifying the necessary data, according to the needs of the research. The identified data is then collected and categorized as primary data (interviews and observations) for decision-making in the research completion and secondary data (Anthropometric data and Clinical Business Standards) as the main reference in problem-solving.

C. Data Processing

Data processing is carried out through three main phases that align with the problem-solving method approach. These three phases include the Inspiration Phase, Ideation Phase, and Implementation Phase in accordance with the Human-Centered Design approach. Each phase is designed to contribute systematically in line with the Double Diamond method in identifying, designing, and implementing solutions to address the formulated problem.

1) Inspiration

This phase is the initial phase in Human Centered Design, Inspiration aims to identify problems based on the data that has been collected. This data will then be analyzed to find the existing problems, so that in the next phase it will provide an overview of the problems to be solved through solutions in the form of ideas and concepts..

2) Ideation

Based on the empathize stage, which includes interviews, observations, empathy maps, and customer journey maps, this research has progressed to the next step in the Double Diagram Diamond method, namely the define stage. The review obtained from the previous stage suggests several needs of the patients/children, which will later be clarified in the form of a needs statement table.

3) Implementation

In the previous phase, through the two earlier stages, the discover stage and the define stage, problems and solutions were identified using several methods/tools in the ideate phase, leading this research to the next step in the Human-

Centered Design approach, which is to implement through Prototyping to minimize errors. Therefore, the implementation phase serves as an evaluation of the ideas and concepts designed to determine whether they align with the initial goals and concepts.

IV. RESULTS AND DISCUSSION

A. Discover

The results of data processing in the analysis for the space serve as benchmarks and are very important in designing a comfortable and safe environment for patients. From the measurements of light, temperature, air, and sound, there are several aspects that need to be improved to enhance the comfort of the Action Room and comply with applicable standards. Anthropometric data also serves as a benchmark in providing the dimensions of each element in the Proposed Improvement Design for the Action Room to ensure user comfort.



Figure 5 Empathy Map



Figure 6 Customer Journey Map

With the mapping of the Empathy Map and Customer Journey Map, it can be determined that criticism regarding poor lighting, noise, and air circulation should be the focus for improving the design of the Action Room, as indicated by the complaints from the interview results.

B. Define

Based on the Discover stage, which includes interviews, observations, Empathy Map, and Customer Journey Map, this design moves to the next step in the Double Diamond Diagram method, namely the Define stage. The results from the previous stage provide several aspects needed by the Patient/child, these needs are interpreted in Table IV-7 Needs Statement. This table encompasses all the needs and desires from the previous stage to be used in the Ideate stage.

Table 1 Needs Statment

No.	Needs Statement
1.	The Action Room must have bright lighting when in use.
2.	The Action Room must have good air circulation.
3.	The Action Room is designed to have a quieter sound.
4.	The Action Room facilities must be ergonomic and child-friendly.
5.	The Action Room needs to be designed with child-friendly elements in mind.
6.	The Action Room must provide enough space for surgical procedures to be carried out safely and comfortably.

C. Tahap Develop

The Develop stage in the Double Diamond Diagram method is the creative part where various ideas and innovative solutions are developed to address the problems identified in the previous stage. This stage is a step in designing solutions based on the Needs Statement, which prioritizes the process of exploring as many ideas as possible to find the most effective solution. This process requires Design Requirements as the ideas or foundation for the proposed improvements. The Design Requirements for the Proposed Improvement Plan for the Action Room can be seen in Table IV-8.

1) SCAMPER

SCAMPER is an acronym for Substitute, Combine, Adapt, Modify, Put to Another Use, Eliminate, and Reverse, which is used as a trigger question to manipulate and modify existing ideas, thereby generating variations and changes to the idea to produce new ideas [14].

The Proposed Improvement Design in this research aligns with the context intended in the problem objectives in the previous section, referring to the redesign of the Action Room to make it more child-friendly while still being usable for other medical purposes in the Action Room.

Therefore, the Proposed Improvement Design must be adjusted to the needs of the Patients using the room by considering Ergonomic Aspects according to the needs taken from the Needs Statement in Table IV-7. The Proposed Improvement Design must also comply with Table IV-8 Design Requirements, which is done using the SCAMPER technique.

Table 2 SCAMPER Question Reference

Poin	Pertanyaan
S	What parts of the Action Room were modified and replaced to be more child-friendly and ergonomic in the Proposed Improvement Plan?
C	Are there parts that can be combined so that the Action Room can be multifunctional, and what would the combination be?
A	Are there any facilities, elements, or furniture added in the Proposed Improvement Plan?
M	What are the recommended parts in the proposed design?
P	Can the Proposed Improvement Plan be more effective in its implementation?
E	Are there any facilities that have been removed from the Operating Room?
R	Does the Proposed Improvement Plan change the layout of medical equipment or other elements?

Substitute means replacing design elements with better ones. The redesign of the Action Room aims to make it more child-friendly while remaining functional for other medical procedures. Some furniture, such as instrument tables and examination tables, need to be adjusted to be more ergonomic and child-friendly. Combine: Combining several pieces of furniture such as medical tables, medical mattresses, and cabinets into one to create a more efficient space that meets the applicable standards. Adapt: Adjust the Operating Room with the necessary facilities to make it more child-friendly, ergonomic, and compliant with medical standards.

Modify: Changing furniture such as tables and medical cabinets to optimize space and adjust sizes as needed. Put to Another Use: Considering the use of customized design elements for other facility spaces at Adiva Husada Clinic. Eliminate means removing or adjusting design elements. Medical equipment such as oxygen tanks and infusion poles were not removed, but adjusted and stored in a modified warehouse to create a more efficient space and reduce the fear of child patients.

Table 3 SCAMPER Elemen Ruang Tindakan

No.	Keterangan	S	C	A	M	P	E	R
1	Tirai kamar mandi	S			M		E	
2	Stand Lamp tindakan	S			M			
3	Penutup tindakan (untuk Pasien anak)	A						
4	Meja periksa		C		M	P		
5	Meja Instrument		C		M	P		
6	Tirai ke Ruang Administrasi				M			
7	Ruang penyimpanan perlengkapan	S		A	M			
8	Jendela cahaya			A				
9	Air Conditioner			A				
10	Lemari obat	S			M			
11	Pintu ke Ruang Tunggu				M			

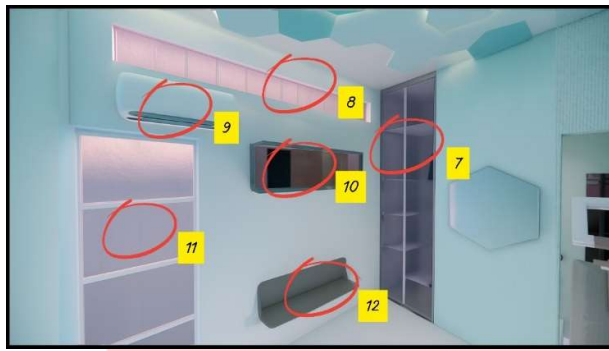


Figure 9 Initial Prototyping awal (continued)



Figure 10 Initial Prototyping awal (continued)



Figure 11 Initial Prototyping awal (continued)

E. Verifikasi Hasil

Tabel 4 Verifikasi rancangan

Aspek	Target Spesifikasi	Hasil Rancangan	Kesesuaian Rancangan
Cahaya	300 - 500 lux	450 lux	sesuai
Suhu & Udara	22°C - 27°C	Suhu dapat diatur	belum dapat ditentukan
Suara	40 - 45 dB(A)	40.54 dB(A)	sesuai
Ergonomi	Luas Ruang Tindakan minimal 7 m ²	Luas Ruang Tindakan Awal dan Prototyping 2.5 × 3 m = 7.5 m ² ,	sesuai

Aspek	Target Spesifikasi	Hasil Rancangan	Kesesuaian Rancangan
	Sesuai dengan Data Antropometri	Menyesuaikan Data Antropometri yang digunakan untuk setiap Dimensi	sesuai

1) Cahaya

usulan lampu yang digunakan berspesifikasi daya 18 watt dan total iluminasi cahaya 1800 lm untuk dapat sesuai dengan standar yang berlaku, yaitu 300-500 lux. Namun dalam perhitungan ini, lux yang ingin dicapai adalah 450 lux sebagai titik paling baik dalam menentukan cahaya. Perhitungan terkait kuantitas iluminasi dan jumlah lampu, ditinjau dari penelitian yang dilakukan oleh Putra dkk. (2023) berdasarkan SNI 03-6575-2001 adalah sebagai berikut:

$$\phi = E \times A$$

$$\phi = 450 \text{ lux} \times 10 \text{ m}^2$$

$$\phi = 4500 \text{ lm}$$

$$N = \frac{E \times A}{F \times n}$$

$$N = \frac{4500 \text{ lm}_1}{1800 \text{ lm}_2}$$

$$N = 2.5 \text{ (3 Lampu)}$$

2) Suhu dan Udara

Temperature and Air in the Operating Room, which previously used a fan, have been replaced with an Air Conditioner, with the aim of maintaining the temperature and air conditions to enhance the comfort of child patients. Generally, the use of an Air Conditioner can adjust to the needs of temperature, wind speed, and humidity produced. In the proposed design presented in Table IV-14, the recommended Air Conditioner is 1 PK. The proposal for using the AC is adjusted according to the heat load from the Operating Room, which includes the heat load on the surface of the Operating Room, the heat load from the occupants of the Operating Room, the heat load from window transmission, and the heat load from the lights. The following is the calculation based on the research conducted by Rasyid. [15].

$$Q_{Tr} = K \times A \times \Delta T \text{ (celcius)}$$

$$Q_{Tr} = 0.6 \times 39 \text{ m}^2 \times 4^\circ\text{C} = 93.6 \text{ watt}$$

K : Konduktivitas Termal

A : Luas dinding dan lantai yang terpapar panas

ΔT : Perbedaan suhu antara luar dan dalam ruangan (T0- T1)

$$Q_p = \text{Heat Rate} \times Q_{ty}$$

$$Q_p = 100 \text{ watt} \times 5 \text{ orang} = 500 \text{ watt}$$

Heat Rate : Panas dari tubuh manusia (86Kcal/h)

Qty : Jumlah Penghuni

$$Q_w = K \times A \times \Delta T \text{ (celcius)}$$

$$Q_w = 0.7 \text{ W/m}^2\text{C} \times 0.48 \text{ m}^2 \times 4^\circ\text{C} = 1.344 \text{ watt}$$

$$Q_L = \text{Qty Lampu} \times A \times \Delta T (\text{celcius})$$

$$Q_L = (3 \text{ lampu} \times 18 \text{ watt}) \times 10 \text{ m}^2 \times 4^\circ\text{C} = 216 \text{ watt}$$

$$Q_{Total} = Q_{Tr} + Q_P + Q_W + Q_L$$

$$Q_{Total} = 93.6 + 500 + 1.344 + 216 = 810.944 \text{ watt}$$

$$1 \text{ watt} = 3.412 \text{ BTU/h}$$

$$810.944 \text{ watt} \times 3.412 \text{ BTU/h per watt} = 2766.94 \text{ BTU/h}$$

$$\frac{2766.94 \text{ BTU/h}}{9000 \text{ BTU/h}} = 0.3074 \text{ (AC 1 PK)}$$

3) Suara

Prototyping provides several solutions in reducing noise through ideas and concepts. The concept is a rubber seal at the door's edge and the use of Acoustic Panels with a total panel area of 4 m² in the Operating Room to reduce noise. As it is known, the Operating Room has a noise level of 61.3 dB(A) and reaches a peak of 101 dB(A) when a child patient screams during a circumcision operation..

Prototyping using Fiber 600 has a thickness of 6 mm with a Sound Transmission Class (STC) coefficient of 24 dB and a Noise Reduction Coefficient (NRC) of 0.63, so the resulting noise calculation is as follows:

$$NR = TL + \log \frac{a_2}{s}$$

$$NR_{Akhir} = IL1 - IL2$$

$$\frac{a_2}{s} = \frac{0.6}{4} = 0.15$$

$$11 + \log 10(0.15) = 11 \times (-0.8239) = 2.76 \text{ dB}$$

$$NR_{Seharusnya} = 24 + 2.76 = 26.76 \text{ dB}$$

$$NR = 26.76 - 6 \text{ dB} = 20.76 \text{ dB (IL2)}$$

Maka;

$$NR_{Akhir} = 61.3 \text{ dB} - 20.76 = 40.54 \text{ dB}$$

Pemakaian Panel : 4 m²

NRC (Noise Reduction Coeff.) : 0.6

STC (Sound Transmission Class) : 24 dB

Daya serap Noise (59 - 4) : 55m²

V. ANALISIS

The results of the problem identification lead to the Operating Room with all its limitations, which serves as the main basis for creating the Improvement Proposal Design. This design aims to address the issue of children's discomfort, while regulations state that one of the efforts to improve children's health is to enhance health facilities. However, due to the limitations of the Action Room, it is necessary to redesign all aspects of the Action Room's needs and limitations to provide comfort to child patients. Child patients can be comfortable if there is an improvement in health facilities+.

The proposed design in the form of 3D model prototyping is considered a viable solution if it addresses the issues identified in the problem identification. The solution can be fulfilled if the identified causes of the problem have been resolved properly and appropriately. The Improvement Proposal Design is then created by considering the Need Statement and Design Requirements, which emphasize several ergonomic aspects in addressing the issue.

The final results of the Prototyping and testing through the Likert scale indicate the success of this research. This is shown on the Likert scale and feedback. The Likert scale shows an average data distribution reaching >80%, indicating that the Proposed Improvement Design is appropriate and acceptable to users. Feedback was conducted with all users to adjust to their needs, resulting in several evaluations and inputs on the first Prototyping design, followed by adjustments.

The Lighting Aspect has reached a point in accordance with the design recommendations made, and systematic calculations yield 450 lux. If there is a discrepancy in the final implementation, the lighting from ambient lamps and sunlight has also sufficed for the Operating Room, and any unmet lighting conditions can still be fulfilled for medical procedures with the Procedure Stand Lamp.

Noise, just like lighting, has achieved the desired results for the proposed design in reducing incoming and outgoing sound through the prototyping of the materials used. Noise in the Operating Room occurs when there are unwanted sounds when the Operating Room is in use or not in use..

In the calculation of temperature and air, although it is indirectly deemed feasible in the final analysis, it still considers the condition where the Operating Room in the proposed design can regulate the desired temperature and air. Temperature and air, although they can be regulated through an air conditioner, require inspection, cleaning, and fully opening doors to minimize the accumulation of bacteria in the air humidity through the air conditioner. Therefore, the Proposed Improvement Plan for the Action Room can still be considered feasible, although there is still a possibility of extreme humidity and dust accumulation if regular maintenance is not performed.

Natural air circulation is also necessary by opening all doors when not in use. Natural air circulation occurs when the Operating Room door and the connecting door to the administration room are opened. Air circulation in the Operating Room bathroom has also been fulfilled by providing an air filter system through the ceiling. This aims to provide adequate comfort in all aspects of temperature and air to ensure comfort.

All elements in the Action Room have also been well fulfilled, as evidenced by the needs met through applicable standards and user requirements available in the Action Room, including supporting elements such as Hand Sanitizer.

VI. CONCLUSION AND RECOMMENDATIONS

In this study, the analysis shows that the Action Room at Adiva Husada Clinic has deficiencies in several ergonomic aspects that can affect patient comfort, especially children. Some of the issues found include insufficient lighting, poor

air circulation, inappropriate temperature, and disturbing noise. Data obtained through interviews, observations, and direct measurements indicate that these elements significantly affect patient comfort during medical procedures, particularly circumcision. Based on this analysis, it is recommended to improve the design of the Action Room with a focus on enhancing lighting, managing temperature and air, and reducing noise. The implementation of these improvements will not only enhance patient comfort but also ensure that the Action Room meets the applicable standards, improves service quality, and increases patient satisfaction at Adiva Husada Clinic.

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