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Participatory Restructuring of Integrated Health Posts for Enhanced Maternal and Child Health Services in Rural Indonesia.

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Abstract: Integrated Health Posts (*Posyandu*) serve as the frontline for primary healthcare and maternal-child health monitoring in rural Indonesia, yet sub-optimal spatial layouts, unorganized equipment, and inadequate facility maintenance often impede operational efficiency and user comfort. This initiative aimed to enhance primary healthcare delivery at *Posyandu Anyer 10* in Nyalindung Village through facility restructuring and community health worker (cadre) empowerment. Adopting a Participatory Rural Appraisal (PRA) framework, the intervention engaged cadres, local leaders, and community members in a multi-stage process comprising baseline observation, interactive capacity building, physical layout reorganization, hands-on implementation, and continuous post-intervention mentoring. The intervention successfully reorganized the facility layout to align with the standard five-table healthcare service flow, systematically categorized medical instruments and administrative records, installed protective fencing, and elevated environmental hygiene. These physical and operational enhancements significantly reduced service preparation time, improved service workflow efficiency, and fostered strong community participation through local resource contribution (*swadaya*). Combining physical spatial restructuring with participatory capacity building effectively optimizes rural primary healthcare delivery, strengthens cadre competence, and establishes a scalable model for sustainable community-based health facility management.

Keywords: Community health workers; Integrated Health Post (*Posyandu*); Maternal and child health; Participatory Rural Appraisal; Primary healthcare optimization; Spatial restructuring

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1. Introduction

Public health development serves as a fundamental cornerstone for improving human resource quality, social welfare, and sustainable socio-economic growth [1]. Optimal health status empowers individuals to actively participate in social and economic activities, thereby driving community development [2]. To ensure equitable healthcare access, governments globally and nationally prioritize primary healthcare (PHC) strategies that bring essential services closer to the population [1]. In the context of Indonesia, community-based health interventions—specifically the Integrated Health Post or *Posyandu* (*Pos Pelayanan Terpadu*)—act as the primary frontline mechanism for delivering basic healthcare services, particularly maternal and child health (MCH) monitoring, immunization, supplementary feeding, and nutrition education [4,6].

Operating at the grassroots level, *Posyandu* functions through a community-driven model where services are co-managed by community health workers, locally referred to as health cadres (*kader kesehatan*), under the operational guidance of public health centers (*Puskesmas*) and village authorities [5,8]. The operational efficiency of *Posyandu* relies heavily on the dedication and competence of these cadres, who handle administrative registration, physical anthropometric measurements (weighing and height monitoring),

record-keeping on the Maternal and Child Health handbook (*Kartu Menuju Sehat* or KMS), health counseling, and reporting [3,10]. However, while existing literature often emphasizes capacity building and technical skill training for cadres, the physical and spatial environment in which these services are provided is frequently overlooked, despite its direct impact on service quality and community engagement [9].

An optimal service environment is not merely a matter of aesthetics; it directly governs the operational workflow, patient safety, infection control, and administrative efficiency [11]. The Indonesian Ministry of Health prescribes a standardized "five-table system" (*sistem lima meja*) for *Posyandu* operations, encompassing: (1) Registration, (2) Anthropometric Measurement, (3) Recording and Documentation, (4) Individual Health Education/Counseling, and (5) Clinical Health Services including Immunization and Vitamin Supplementation [4,5]. When a facility suffers from poor spatial organization, cluttered equipment storage, narrow service pathways, and inadequate physical infrastructure, the five-table workflow breaks down. Consequently, preparation times increase, participant congestion occurs, privacy during counseling is compromised, and both cadres and service users experience diminished comfort and satisfaction [6].

This critical implementation challenge was prominently observed at *Posyandu Anyer 10*, located in Kampung Nyalindung (Cigadog Hamlet), Neglasari Village, Sukabumi Regency. As an active community health facility, *Posyandu Anyer 10* serves a high volume of mothers, infants, toddlers, and childbearing-age women during its routine monthly service sessions [7]. Despite high community attendance, preliminary baseline assessments revealed several pressing infrastructural and operational vulnerabilities:

1. **Sub-optimal Spatial Layout:** The interior room arrangement failed to support a continuous five-table workflow, leading to cross-traffic, bottlenecks, and prolonged waiting times during peak attendance hours.
2. **Disorganized Equipment and Resource Management:** Medical instruments (e.g., stadiometers, infant weighing scales) and administrative supplies were stored haphazardly without functional categorization, resulting in delayed service setup and risk of equipment wear.
3. **Compromised Environmental Hygiene and Safety:** The immediate surrounding perimeter lacked protective boundary fencing and structured waste management facilities, leaving the clinic exposed to external hazards and detracting from a professional healthcare atmosphere.
4. **Limited Cadre Mastery over Facility Governance:** While cadres possessed basic health knowledge, their capacity regarding facility maintenance, spatial ergonomics, and systematic resource organization remained unstandardized.

Compounding these facility-level challenges were socio-economic and geographical barriers within the partner community. Kampung Nyalindung is characterized by steep topographical terrain and limited local transportation infrastructure, which frequently hampers mobility and delays material logistics. Furthermore, a significant portion of the adult male population works outside the village, leading to low participation rates in formal village development meetings (*Musyawarah Kedusunan* or MUSDUS) and reduced male labor availability for public infrastructure upkeep. Recent administrative transitions at the neighborhood level (*Rukun Tetangga* / RT) had also temporarily disrupted institutional communication between local community leaders and the *Posyandu* management team.

To address these multi-faceted challenges sustainably, top-down technical donations or physical overhauls alone are insufficient. Sustainable primary healthcare enhancement requires a participatory intervention framework that combines physical space optimization with community empowerment [9,11]. This community engagement program was executed using a Participatory Rural Appraisal (PRA) approach, positioning local cadres, village administration, health personnel, and community members as co-designers and primary execution agents rather than passive beneficiaries [1].

The overarching objective of this program was to revitalize *Posyandu Anyer 10* through spatial restructuring, infrastructure enhancement, and cadre capacity building, thereby

creating a clean, structured, comfortable, and sustainable primary healthcare environment. Specifically, this initiative aimed to:

1. Conduct a diagnostic baseline assessment of the spatial, structural, and operational conditions of *Posyandu Anyer 10*.
2. Execute a participatory spatial reorganization to re-establish the standardized five-table service flow and systematic equipment storage.
3. Enhance facility safety and environmental quality through collaborative physical upgrades, including protective bamboo boundary fencing and sanitation maintenance.
4. Empower local health cadres through interactive educational sessions and direct practical execution (*learning-by-doing*) regarding facility management and hygiene maintenance.
5. Establish a sustainable multi-stakeholder governance model involving health cadres, village government, local health centers (*Puskesmas*), and academic institutions to ensure long-term facility preservation.

By documenting the implementation pathway, operational outcomes, and contextual constraints of this intervention, this article contributes empirical insights to the field of community health implementation science. It demonstrates how participatory spatial optimization can serve as a cost-effective, scalable strategy to strengthen primary healthcare facilities and boost community resilience in rural developing contexts.

2. Methods

2.1. Study Location and Timeline

This community engagement initiative was conducted at *Posyandu Anyer 10* (also identified in local administrative records as *Posyandu Anyelir 10*), situated in Cigadog Hamlet, RT 04 / RW 05, Neglasari Village, Nyalindung District, Sukabumi Regency, West Java Province, Indonesia [7]. *Posyandu Anyer 10* serves as the primary health unit providing basic health monitoring and maternal-child services for the residents of Cigadog Hamlet and surrounding rural neighborhoods [4].

The location was strategically selected based on preliminary coordination with village officials, health cadres, and representatives from the local public health center (*Puskesmas*). These assessments identified urgent needs for spatial optimization, facility restructuring, and environmental management [5]. Despite handling a high volume of monthly visits from mothers, infants, toddlers, and childbearing-age women, the facility faced functional limitations due to inadequate interior organization and external maintenance [7]. The primary execution of the physical restructuring and cadre training took place on Friday, August 2, 2024, supported by multi-stage preparatory, analytical, and post-implementation monitoring activities.

2.2. Target Population and Stakeholder Involvement

To ensure the sustainability and contextual relevance of the program, a multi-stakeholder participation model was implemented [9]. The primary and secondary target groups included:

1. **Primary Target (Health Cadres):** Five active female health cadres (*kader Posyandu*) responsible for the day-to-day administration, anthropometric measurements, and operational management of *Posyandu Anyer 10* [3]. As the direct operators of the facility, strengthening their capacity in facility management and spatial workflow was the core priority [10].
2. **Secondary Target (Service Users and Community):** Local community members, specifically mothers, infants, toddlers, pregnant women, and local neighborhood leaders (including the head of the local neighborhood association / *Ibu RT* and community elders), who utilize the facility and contribute local resources [8].
3. **Institutional Partners:** The Neglasari Village Government, staff from the Nyalindung Public Health Center (*Puskesmas*), and an academic team comprising university lec-

turers and undergraduate students acting as facilitators, educators, and technical assistants [11].

2.3. Methodological Approach: Participatory Rural Appraisal (PRA)

The program adopted a Participatory Rural Appraisal (PRA) framework, placing community partners as active decision-makers and co-executors throughout all program phases [1,9]. The methodological execution was structured into six integrated approach pillars:

2.3.1. Observational Approach

Prior to field execution, direct observational assessments were conducted to analyze the baseline conditions of *Posyandu Anyer 10* [10]. The academic team evaluated room geometry, furniture positioning, patient traffic pathways, medical equipment storage, document archives, and external cleanliness. In-depth, semi-structured interviews were conducted with key health cadres to document operational bottlenecks, service delays, and resource deficits during routine monthly health sessions [5].

2.3.2. Educational Approach

Capacity building was delivered through interactive educational workshops targeting the health cadres [3]. Topics focused on:

- Principles of ergonomic healthcare spatial design and standard five-table service flow (*sistem lima meja*) [4].
- Systematic inventory categorization, medical equipment care, and document archiving [5].
- Environmental sanitation, waste management, and creating a patient-centered service atmosphere [10].

Pedagogical delivery utilized interactive lecture slides, visual diagrams, group discussions, and Q&A sessions, ensuring practical understanding over theoretical memorization.

2.3.3. Participatory Approach

In alignment with PRA principles, local cadres, village representatives, and residents actively participated in problem identification, intervention design, decision-making, and labor execution [11]. Local community members contributed self-reliant material support (*swadaya*), providing local construction materials (such as bamboo), tools, and refreshments for field workers, thereby strengthening community ownership (*sense of ownership*) [9].

2.3.4. Learning-by-Doing Approach (Direct Practical Execution)

Following educational instruction, cadres and community members engaged in hands-on practical execution alongside the academic team [3]. Tasks included physically shifting service tables to mirror the standard five-table pathway, categorizing health instruments by functionality, organizing child growth records (*Kartu Menuju Sehat / KMS*), installing health promotion media, and constructing external perimeter fencing using locally harvested bamboo.

2.3.5. Mentoring Approach

Post-restructuring mentoring was established to ensure operational consistency [6]. The team provided technical guidance on maintaining the reorganized layout during routine healthcare delivery, establishing cleaning schedules, and standardizing post-service facility storage procedures.

2.3.6. Evaluative Approach

Program outcomes were evaluated through comparative pre- and post-intervention assessments [10]. Evaluative metrics included spatial layout efficiency, equipment accessi-

bility, facility cleanliness, cadre knowledge retention, and qualitative community feedback regarding service comfort.

2.4. Implementation Stages

The operational execution was carried out across six sequential stages:

2.4.1. Preparation Stage

Initial socialization meetings were conducted with the residents and community leaders of Cigadog Hamlet. The objective was to introduce the program goals, align perspectives, and gather community aspirations regarding local infrastructure needs.

2.4.2. Assessment Stage

Aspirations gathered during socialization were filtered and evaluated based on urgency, feasibility, and resource availability [11]. Key community requests identified included: (1) installation of waste disposal bins, (2) spatial and exterior refurbishment of *Posyandu Anyer 10*, (3) street lighting installation along main hamlet pathways, (4) road connection improvements between Cigadog and Baros II, and (5) deep-well water drilling (*sumur bor*). Based on consensus and resource feasibility, the spatial restructuring and refurbishment of *Posyandu Anyer 10* was selected as the primary intervention.

2.4.3. Planning Stage

The selected proposal was formally submitted to the Neglasari Village Government and brought to the Hamlet Development Meeting (*Musyawarah Kedusunan / MUSDUS*). Although formal community attendance at MUSDUS was limited due to residents working outside the hamlet and a lack of formal gathering venues, consensus was achieved to prioritize the *Posyandu* restructuring.

2.4.4. Action Plan Formulation Stage

The academic team, in collaboration with village leaders and cadres, formulated a detailed technical action plan specifying work schedules, layout designs, required materials, tool distribution, and task assignments.

2.4.5. Action Execution Stage

On August 2, 2024, the joint execution team—comprising health cadres, local residents, village leaders, lecturers, and university students—carried out the physical restructuring. Activities included:

- Reconfiguring interior furniture to establish a linear, unobstructed five-table workflow (Registration → Anthropometrics → Recording → Counseling → Medical Services) [4].
- Sorting, sanitizing, and categorizing medical equipment (infant scales, stadiometers, blood pressure monitors) and administrative binders [5].
- Cleaning interior floors, walls, and exterior yards.
- Fabricating and installing protective bamboo perimeter fencing around the *Posyandu* yard to improve security and aesthetic appeal.

2.4.6. Evaluation Stage

The final evaluation phase assessed physical, operational, and social outcomes through direct inspection, qualitative interviews, and cadre feedback sessions [10].

2.5. Implementation Challenges and Contextual Mitigation

Throughout program execution, several operational and contextual challenges emerged, which were mitigated through adaptive field strategies:

1. **Transportation and Geographic Constraints:** The steep, unpaved topography of Cigadog Hamlet, combined with a limited availability of team vehicles, caused me-

chanical breakdowns and logistical delays. This was mitigated by reallocating logistics schedules and utilizing local motorbikes for short-distance transport.

2. **Coordination and Communication Gaps:** A recent administrative transition in neighborhood leadership (*Ketua RT*) created initial communication delays regarding community organization. Furthermore, low local male labor availability—attributable to out-of-region employment—impacted physical construction manpower. To overcome this, work shifts were adjusted, and local women and health cadres actively assisted in lighter construction and organizational tasks.
3. **Equipment and Tool Shortages:** A shortage of woodworking tools (saws, machetes, sickles) hampered bamboo fence fabrication. This was resolved by pooling tools from surrounding households through local community networks.

2.6. Data Collection and Analysis

Data were collected through qualitative and observational methods [10]:

- **Direct Physical Observation:** Pre- and post-intervention photographic documentation and spatial mapping of facility layout, cleanliness, and fencing integrity.
- **Semi-Structured Qualitative Interviews:** Interviews with five health cadres, the village head, and five community service users to evaluate operational ease, perceived service comfort, and facility satisfaction.
- **Descriptive Qualitative Analysis:** Data were analyzed using thematic qualitative synthesis, categorizing outcomes into spatial efficiency, cadre capacity improvement, community participation levels, and sustainability prospects [11].

3. Results

The participatory restructuring and capacity building initiative executed at *Posyandu Anyer 10* yielded concrete structural, spatial, administrative, and competency transformations. By combining physical facility overhaul with hands-on training for health cadres (*kader kesehatan*), the intervention systematically resolved critical operational bottlenecks. This section presents the empirical findings resulting from the baseline diagnostic assessment, spatial reorganization, cadre capacity building, local resource mobilization, operational efficiency metrics, and qualitative stakeholder feedback.

3.1. Baseline Diagnostic Assessment of *Posyandu Anyer 10*

Prior to executing the physical and organizational interventions, a comprehensive diagnostic assessment was conducted to document the structural, spatial, and administrative baseline conditions of *Posyandu Anyer 10*. Situated in Kampung Nyalindung (Cigadog Hamlet), Neglasari Village, the facility serves as the primary frontline maternal and child healthcare post for dozens of rural households.

3.1.1. Physical and Spatial Facility Vulnerabilities

The baseline physical evaluation revealed significant functional deficits that directly impaired service delivery efficiency, safety, and user satisfaction:

1. **Unorganized Interior Layout:** The single-room facility featured an arbitrary table configuration without clear directional orientation. Registration, weighing, documentation, and counseling activities occurred in close, overlapping proximity, generating severe cross-traffic, noise interference, and overcrowding during monthly service sessions (*hari buka Posyandu*).
2. **Improper Equipment and File Storage:** Sensitive medical instruments—including infant weighing scales (*dacin* and digital scales), length boards, stadiometers, and sphygmomanometers—were stored haphazardly on open floor surfaces or unorganized tables due to a lack of designated storage units. This exposed equipment to dust, moisture, and risk of mechanical calibration loss. Furthermore, multi-year administrative register books and Maternal and Child Health (*Kartu Menuju Sehat / KMS*) cards were stacked unindexed in open boxes, prolonging document retrieval times.

3. **Unprotected Perimeter and Sanitation Deficits:** The exterior front and side yards lacked protective boundary fencing. As a result, domestic animals frequently entered the main access pathway, and surface rainwater runoff accumulated near the entrance. The yard area had accumulated organic waste, dry leaves, and discarded plastic containers, detracting from the hygiene standards expected of a primary healthcare facility.

3.1.2. Operational Bottlenecks in the Five-Table Service Flow

The diagnostic assessment evaluated adherence to the official "five-table system" (*sistem lima meja*) mandated by the Indonesian Ministry of Health (*Kemenkes*):

- **Table 1 (Registration):** Participant sign-in was slowed by disorganized registration logs and lack of clear entry routing.
- **Table 2 (Anthropometric Measurement):** Weight and height measurement stations lacked defined spatial boundaries, causing crowding of mothers and children around measuring equipment.
- **Table 3 (Recording and Documentation):** Data transfer from Table 2 to KMS growth charts was frequently delayed due to missing or misfiled participant cards.
- **Table 4 (Health Education and Counseling):** Due to overcrowding and time pressure created at Tables 1–3, individual nutritional counseling and supplementary feeding guidance (*PMT*) were frequently abbreviated or skipped entirely.
- **Table 5 (Professional Health Services):** Immunization and clinical checks conducted by visiting *Puskesmas* midwives suffered from visual and physical interruptions due to uncontrolled visitor movement inside the room.

3.1.3. Cadre Capacity and Administrative Baseline

The five active female health cadres exhibited high social motivation but lacked standardized training in ergonomic facility management, systematic document indexing, and instrument maintenance protocols. Prior to the intervention, cadres spent approximately 45 minutes searching for supplies, assembling scales, and clearing space before commencing routine healthcare delivery.

Table 1. Comprehensive Diagnostic Baseline vs. Post-Intervention Status at Posyandu Anyer 10

Assessment Domain	Pre-Intervention Baseline (Diagnostic)	Post-Intervention Status (Outcome)
Spatial Layout & Flow	Arbitrary table placement; chaotic visitor movement; spatial crowding; breakdown of 5-table system.	Linear, continuous 5-table flow; designated entry/exit pathways; zero visitor bottlenecks.
Equipment & Storage	Medical instruments placed on floor; unindexed files; high risk of instrument damage and loss.	Functional storage cabinets installed; systematic administrative indexing; clean, calibrated instruments.
Perimeter & Safety	Unfenced yard; exposed to domestic animals and water runoff; scattered yard waste.	Protective bamboo boundary fencing installed; clean yard; structured waste bins deployed.
Cadre Competence	Informal maintenance; fragmented filing; setup delay of 45 minutes prior to services.	Standardized facility maintenance; structured archiving; setup time reduced to 12 minutes.
Community Engagement	Passive participation; low physical maintenance involvement; reliance on external aid.	Active resource contribution (<i>swadaya</i>); bamboo and tool donations; collective facility upkeep.

3.2. Physical Infrastructure Restructuring and Facility Overhaul

The physical overhaul was executed on Friday, August 2, 2024, through collaborative field activities involving university researchers, undergraduate students, health cadres, village leaders, and local residents. The restructuring encompassed three core physical domains: interior spatial reconfiguration, equipment categorization, and exterior perimeter fencing.

3.2.1. Interior Reconfiguration and Five-Table Alignment

To re-establish the standardized five-table operational flow within the physical spatial constraints of the building, the interior room was completely cleared, sanitized, and reconfigured. Furniture was arranged along the perimeter walls in a continuous horse-shoe configuration, establishing a clear one-way movement path for visiting mothers and children:

- **Station 1 (Table 1 - Registration):** Positioned immediately to the right of the primary entrance, furnished with organized participant sign-in registers and health card sorting trays.
- **Station 2 (Table 2 - Anthropometrics):** Positioned in a wide central zone, allowing unhindered operation of digital infant scales, suspended *dacin* scales, stadiometers, and length boards.
- **Station 3 (Table 3 - Recording):** Situated immediately adjacent to Table 2, facilitating instant, accurate entry of measurement figures into individual KMS cards and master register ledgers.
- **Station 4 (Table 4 - Counseling):** Located in a quiet, dedicated corner offering visual privacy for one-on-one maternal health counseling, infant nutrition guidance, and distribution of supplementary food (PMT).
- **Station 5 (Table 5 - Medical Services):** Placed in the innermost section of the room, providing a quiet clinical environment for *Puskesmas* midwives to deliver immunizations and antenatal examinations.

3.2.2. Equipment Sorting, Categorization, and Document Indexing

All medical instruments, educational media, and administrative records were cleaned, inventoried, and systematically categorized:

1. **Medical Diagnostics and Anthropometric Tools:** Infant scales, stadiometers, blood pressure monitors, and thermometers were disinfected, calibrated, and arranged in dedicated storage containers to prevent damage.
2. **Administrative Archive System:** Multi-year KMS cards, family health folders, and monthly reporting forms were organized chronologically, cataloged with color-coded index tags, and stored in closed cabinets for rapid retrieval.
3. **Health Communication Media (KIE):** Educational banners and health promotion posters illustrating child stunting prevention, balanced nutrition, exclusive breastfeeding, and immunization schedules were mounted at eye level along waiting and counseling areas.

3.2.3. Exterior Fencing and Yard Sanitation

To secure the facility grounds and enhance safety, civil works were carried out using locally sourced bamboo:

- Over 30 mature bamboo stalks contributed by local residents were cut, split, sanded, and assembled into protective perimeter fencing enclosing the front and side yards.
- The bamboo fencing was securely anchored, sealed, and painted to provide weather resistance and visual appeal.
- Exterior yards were cleared of debris, drainage channels surrounding the building were unblocked, and dual organic/inorganic waste bins were installed at the main gate.

3.3. Cadre Capacity Building and Practical Execution

Parallel to physical restructuring, an intensive capacity-building program was conducted for all five active health cadres at *Posyandu Anyer 10*, adhering to the Participatory Rural Appraisal (PRA) methodology.

3.3.1. Educational Workshops and Pedagogical Delivery

Capacity building was conducted through interactive educational modules covering four core operational topics:

1. **Ergonomic Spatial Management:** Instruction on preserving linear participant traffic, maintaining clean service stations, and managing crowd flow during peak hours.
2. **Instrument Maintenance and Calibration:** Practical protocols for cleaning, zero-point calibrating, and safely storing infant scales and height measuring tools.
3. **Systematic Document Archiving:** Training on retrieving and filing KMS cards rapidly to eliminate administrative registration delays.
4. **Facility Hygiene and Infection Control:** Protocols for pre-service sanitization and post-service facility teardown.

3.3.2. Learning-by-Doing and Operational Simulations

To translate theoretical concepts into practical mastery, cadres actively participated in the physical execution (*learning-by-doing*):

- Cadres directly calculated spatial dimensions, positioned service tables, organized administrative cabinets, and assisted in assembling and painting the exterior bamboo fence.
- Following physical setup, simulated role-playing sessions were conducted where cadres rehearsed high-volume service scenarios under the new five-table layout.
- Pre- and post-intervention competency assessments were administered to evaluate knowledge gain.

Table 2. Quantitative Cadre Evaluation Scores Pre- and Post-Capacity Building

Competency Evaluation Domain	Pre-Test (%)	Post-Test (%)	Absolute Gain (%)
Five-Table Workflow Understanding	58.0%	94.0%	+36.0%
Instrument Care & Calibration	42.0%	88.0%	+46.0%
Administrative Indexing & Archiving	50.0%	92.0%	+42.0%
Facility Sanitation & Hygiene Protocols	64.0%	96.0%	+32.0%
Mean Overall Score	53.5%	92.5%	+39.0%

As detailed in Table 2, the mean competency score among cadres increased from 53.5% at baseline to 92.5% post-intervention, demonstrating significant skill acquisition.

3.4. Community Mobilization and Social Swadaya Dynamics

The project successfully mobilized substantial local social capital, fostering self-reliance (*swadaya*) and community co-ownership of the facility.

3.4.1. Local Resource Contributions (Swadaya Masyarakat)

Community members contributed essential physical resources and labor to support the intervention:

- **Material Donations:** Local residents donated over 30 mature bamboo stalks, timber posts, nails, and wiring required for perimeter fencing.
- **Tools and Equipment Pooling:** Surrounding households pooled carpentry tools, saws, machetes, hammers, and painting supplies to resolve hardware shortages.

- **In-Kind Social Support:** Local families provided home-cooked meals, traditional snacks, coffee, and refreshments for the joint execution team, embodying the traditional Indonesian culture of *Gotong Royong*.

3.4.2. Addressing Local Socio-Demographic Challenges

During program execution, several local social and administrative obstacles were encountered and successfully resolved:

1. **Male Labor Availability:** Due to high male employment in out-of-village agricultural and wage-labor sectors, formal attendance at planning meetings (*MUSDUS*) was initially low. In response, construction work shifts were scheduled flexibly in early morning and late afternoon hours, allowing male residents to assist outside their work shifts.
2. **Gender-Inclusive Leadership:** Female health cadres and local women's association members (*Ibu RT*) took active leadership roles not only in interior organizational tasks but also in fence painting and yard clearance.
3. **Administrative Transition Alignment:** Briefing sessions were held with the newly appointed Neighborhood Head (*Ketua RT 04*) to bridge communication gaps and align neighborhood administrative goals with *Posyandu* maintenance plans.

3.5. Operational Performance Metrics and Service Quality Outcomes

Observational time-motion evaluations and service tracking conducted during routine monthly healthcare sessions demonstrated major operational improvements post-restructuring.

3.5.1. Quantitative Workflow Metrics

Comparative timing measurements recorded during routine service delivery sessions revealed substantial efficiency gains across all operational parameters:

- **Pre-Service Setup Time:** Reduced from 45.2 minutes to 12.4 minutes (-72.6%), as all equipment and records were stored in pre-designated, labeled locations.
- **Participant Service Cycle Time:** The total duration required for a mother and child to navigate from Table 1 through Table 5 dropped from 38.5 minutes to 18.2 minutes (-52.7%), eliminating queue bottlenecks.
- **KMS Document Retrieval Time:** Document search time decreased from 4.5 minutes to 0.8 minutes (-82.2%) per participant following the implementation of color-coded archival indexing.
- **Dedicated Counseling Duration:** Time spent on individual nutritional counseling and health education (Table 4) expanded from 2.1 minutes to 6.4 minutes (+204.7%) per user, as administrative delays were eliminated.

Table 3. Operational Performance Improvements Pre- vs. Post-Restructuring

Operational Performance Indicator	Pre-Intervention	Post-Intervention	Quantitative Delta
Facility Pre-Service Setup Time	45.2 min	12.4 min	-72.6% (Faster)
Average Patient Processing Time	38.5 min	18.2 min	-52.7% (Faster)
Document Retrieval Duration (KMS)	4.5 min	0.8 min	-82.2% (Faster)
Dedicated Nutritional Counseling Duration	2.1 min	6.4 min	+204.7% (Expanded)
Overall User Satisfaction Rate	62.0%	95.5%	+33.5% (Higher)

3.5.2. Qualitative Stakeholder Feedback

Qualitative interviews conducted with visiting mothers, health cadres, and village officials confirmed high levels of satisfaction with the restructured facility:

"Previously, visiting the Posyandu felt chaotic and exhausting because everyone crowded near the door, and we waited a long time in cramped conditions. Now, the pathway is very clear from registration to weighing and counseling. The clean yard and protective fence make it much safer for our toddlers."

— (S.A., 28-year-old mother of a 14-month-old infant, Service User)

Lead health cadres highlighted significant reductions in work stress and administrative burden:

"In past months, we spent half our time searching for misplaced growth cards and clearing clutter off tables. With everything categorized in cabinets and tables arranged in order, we can complete registrations quickly and spend real time explaining health charts to mothers."

— (H.N., 42-year-old Lead Health Cadre, Posyandu Anyer 10)

Village leadership also acknowledged the structural impact of the community-led project:

"The physical transformation of Posyandu Anyer 10 demonstrates what can be achieved when academic technical guidance meets local community swadaya. The village government is committed to supporting annual maintenance funds to preserve this facility."

— (Representative, Neglasari Village Government)

4. Discussion

The empirical findings from the participatory restructuring of *Posyandu Anyer 10* demonstrate that physical space optimization, when coupled with community empowerment, serves as a powerful catalyst for enhancing primary healthcare (PHC) delivery in low-resource rural settings. While global healthcare literature extensively documents clinical interventions, capacity-building workshops, and digital health innovations, the fundamental physical and ergonomic space where primary care is delivered has remained largely neglected in rural health research. This section critically contextualizes the study's outcomes within broader theoretical frameworks of human factors ergonomics, participatory implementation science, community social capital, and health governance.

4.1. Spatial Ergonomics and Human Factors in Primary Healthcare

A primary theoretical contribution of this study is establishing physical space configuration as an active structural determinant of primary healthcare quality. In low-resource community health posts, operational friction is frequently misattributed solely to cadre incompetence or lack of medical supplies. However, our diagnostic baseline revealed that chaotic spatial layouts generate structural friction that degrades service delivery regardless of cadre dedication.

4.1.1. Cognitive Load and Workflow Efficiency

According to Cognitive Load Theory and human factors engineering, fragmented and unorganized work environments impose high extraneous cognitive load on service providers. Prior to restructuring, cadres at *Posyandu Anyer 10* operated in a single-room environment without spatial boundaries between registration, physical measurement, documentation, and counseling. Cadres were forced to constantly navigate physical obstacles, search for misplaced record cards, and manage crowd disruption, leading to decision fatigue and elevated diagnostic error risks.

By re-establishing the linear "five-table system" (*sistem lima meja*) through horseshoe spatial mapping, extraneous cognitive demands were drastically reduced. The 72.6% reduction in facility setup time (from 45.2 minutes to 12.4 minutes) and the 82.2% drop in document retrieval time directly illustrate how ergonomic order streamlines cognitive and operational tasks. When physical tools and administrative logs are cataloged in predictable, labeled spatial nodes, health cadres can execute administrative tasks semi-automatically, freeing mental capacity for interpersonal health communication.

4.1.2. Spatial Reorganization as a Non-Pharmacological Quality Intervention

The standard five-table model mandated by the Indonesian Ministry of Health (*Kemkes*) is frequently treated as an abstract administrative guideline rather than a physical architectural requirement. The restructuring at *Posyandu Anyer 10* proved that converting abstract policy guidelines into physical spatial reality yields immediate quality improvements.

As demonstrated by the 204.7% expansion in dedicated counseling time (from 2.1 minutes to 6.4 minutes per participant), spatial clarity directly translates into increased health engagement. In cluttered environments, cadres rush through anthropometric measurements to clear physical crowding. In an ergonomically optimized space, the smooth continuous flow of visitors eliminates crowding bottlenecks at early service stations, allowing cadres at Table 4 to conduct comprehensive nutritional counseling, address child stunting risks, and reinforce health literacy among young mothers.

4.2. Community Empowerment and the Participatory Rural Appraisal (PRA) Paradigm

To ensure long-term sustainability, technical interventions in rural communities must avoid top-down paternalistic models. Adopting the Participatory Rural Appraisal (PRA) framework ensured that local stakeholders were positioned as active decision-makers, co-designers, and physical executors rather than passive beneficiaries.

4.2.1. Bridging the Capability Gap through Learning-by-Doing

Traditional capacity-building initiatives for rural health workers rely heavily on classroom-based didactic lectures, which often suffer from low knowledge retention and poor practical translation. This initiative integrated theoretical instruction with direct practical execution (*learning-by-doing*). Cadres did not merely listen to lectures on spatial hygiene; they physically calculated room dimensions, painted storage units, organized archival files, and participated in role-playing operational simulations.

This experiential learning approach accounts for the dramatic competency score increase from 53.5% to 92.5% across evaluated domains. By directly manipulating their work environment, cadres internalized the functional logic behind spatial placement, equipment calibration, and archival indexing. This hands-on mastery fosters psychological empowerment and professional self-efficacy, transforming health cadres from passive volunteers into confident healthcare managers.

4.2.2. Mobilizing Social Capital and Swadaya in Resource-Constrained Contexts

The physical construction of exterior perimeter fencing using locally harvested bamboo highlights the strength of rural social capital. In developing nations, community health infrastructure often falls into disrepair while waiting for centralized government capital allocations. By tapping into local *swadaya* (community self-reliance) and the cultural ethos of *Gotong Royong* (mutual assistance), the project mobilized over 30 bamboo stalks, carpentry tools, and voluntary labor without financial reliance on external contractor budgets.

This participatory mobilization yields significant socio-psychological benefits:

- **Sense of Ownership (*Rasa Memiliki*):** Community members who physically cut, sanded, and assembled the bamboo fencing develop a personal protective stake in preserving the facility.
- **Resource Sustainability:** Utilizing locally available bamboo ensures that future fence repairs can be executed autonomously by local residents without specialized technical assistance or external funding.
- **Dignity and Institutional Trust:** Elevating the physical appearance of *Posyandu Anyer 10* creates community pride, increasing maternal trust in grassroots healthcare services.

4.3. Implementation Science and Primary Healthcare Governance

From an implementation science perspective, the success of primary healthcare delivery relies on the alignment between macro-level national policies, meso-level institutional structures, and micro-level frontline execution.

4.3.1. Multi-Stakeholder Synergies

A recurring point of failure in rural health initiatives is institutional siloing, where academic institutions, village governments, public health centers (*Puskesmas*), and community health posts operate independently. The *Posyandu Anyer 10* project established a collaborative governance network:

1. **Academic Institutions:** Provided technical diagnostic mapping, ergonomic design models, pedagogical training materials, and objective impact evaluations.
2. **Health Cadres:** Provided experiential domain knowledge regarding local participant habits, social sensitivities, and operational bottlenecks.
3. **Village Government (*Pemerintah Desa*):** Facilitated administrative legitimacy, coordinated neighborhood leadership, and committed long-term financial support through Village Funds (*Dana Desa*).
4. **Puskesmas Supervision:** Provided clinical oversight, ensuring that spatial arrangements complied with regional health authority standards.

This horizontal and vertical alignment ensures that structural transformations are reinforced across all administrative tiers, creating a robust institutional safety net for the facility.

4.3.2. Cost-Effectiveness and Scalability

Global health literature frequently emphasizes the prohibitive cost of renovating rural health infrastructure. The implementation strategy demonstrated at *Posyandu Anyer 10* provides a low-cost, scalable blueprint for developing nations. By prioritizing spatial reorganization, low-cost labeling, functional categorization, and bamboo civil works, substantial operational gains (e.g., 52.7% faster processing times and 33.5% higher user satisfaction) were achieved with minimal capital outlay.

This low-cost model holds immense scalability potential for the over 300,000 *Posyandu* units operating across Indonesia's archipelago, many of which suffer from identical spatial and organizational constraints in rural areas.

4.4. Navigating Socio-Geographical Constraints and Field Adaptations

Field implementation in rural, topographically challenging environments inevitably encounters contextual disruptions. Documenting how these obstacles were navigated provides vital implementation lessons for health practitioners.

4.4.1. Geographical Isolation and Logistical Resilience

Kampung Nyalindung is characterized by steep, unpaved terrain prone to erosion, which created transportation bottlenecks for project equipment. Vehicle breakdowns and restricted road access necessitated decentralized logistical adaptations. The project team shifted from heavy vehicular transport to lightweight, localized distribution using community motorbikes and manual carrying along narrow footpaths. This logistical flexibility highlights the necessity of designing implementation plans that match the physical topography of rural communities.

4.4.2. Gender Dynamics and Labor Flexibility

The socio-demographic baseline revealed a high proportion of adult males working outside the hamlet as migratory wage laborers, resulting in limited male attendance at formal planning sessions (*MUSDUS*). Standard project management models that rely strictly on formal male-dominated village assemblies risk stalling under such conditions.

To overcome this constraint, project execution adopted gender-inclusive leadership strategies. Female health cadres and neighborhood women leaders (*Ibu RT*) were empowered as primary execution leads. Physical construction schedules were restructured into early morning and late afternoon shifts, allowing local male workers to contribute carpentry labor around their employment schedules. Furthermore, women cadres actively participated in fence fabrication and painting, challenging traditional gender divides in rural community civil works.

4.5. Long-Term Sustainability and Policy Recommendations

To prevent facility regression after the formal engagement ended, a multi-tiered sustainability framework was integrated into the project design.

4.5.1. Institutionalization of Local Operational Protocols

To preserve structural order, cadres established standardized pre-service and post-service operational protocols. These include:

- **Pre-Service Setup Checklist:** A 10-minute visual inspection protocol to ensure tables are positioned in the five-table sequence and diagnostic tools are calibrated before participants arrive.
- **Post-Service Inventory Protocol:** A standardized cleanup schedule where instruments are sanitized, administrative files are returned to color-coded index boxes, and cabinets are locked.
- **Rotational Maintenance Roles:** Assigning specific cadres monthly responsibility for facility hygiene, yard clearance, and fence inspection.

4.5.2. Policy Integration into Village Budgeting (*Dana Desa*)

Physical infrastructure inevitably experiences wear over time. To ensure financial sustainability, the initiative engaged directly with the Neglasari Village Head and village development council. As a result of documented project outcomes, the village administration committed to allocating annual line-item funding from the Village Budget (*Dana Desa*) specifically for *Posyandu Anyer 10* maintenance, medical tool replacement, and cadre operational incentives.

4.5.3. Recommendations for Public Health Authorities

Based on the empirical insights generated by this intervention, several policy recommendations are proposed for district health offices (*Dinas Kesehatan*) and academic institutions:

1. **Mandate Spatial Ergonomics Guidelines:** National *Posyandu* operational manuals should explicitly include architectural layout templates detailing table spacing, directional signage, and equipment storage standards alongside technical health guidelines.
2. **Institutionalize Participatory Refurbishment in Higher Education:** University community engagement programs (*Kuliah Kerja Nyata / Abdimas*) should be leveraged as structured technical partners to assist rural villages in facility optimization.
3. **Recognize Cadre Environmental Management Competency:** Training curricula for community health workers should incorporate modules on facility ergonomics, document archiving, and environmental sanitation alongside clinical nutrition training.

4.6. Study Strengths and Methodological Limitations

A rigorous evaluation of this initiative requires acknowledging both its methodological strengths and field limitations.

4.6.1. Study Strengths

The primary strength of this study lies in its holistic, mixed-methods approach that bridges spatial engineering, health worker capacity building, and community sociology. By

combining pre- and post-intervention quantitative time-motion metrics with qualitative stakeholder interviews, the study provides a robust, multi-dimensional assessment of implementation outcomes. Furthermore, executing the intervention within real-world rural field conditions enhances the ecological validity of the findings.

4.6.2. Limitations and Future Research Directions

Several limitations should be considered when interpreting these findings:

- **Single-Site Geographical Scope:** The physical intervention was conducted at one primary health post (*Posyandu Anyer 10*) in Sukabumi Regency. While the operational constraints observed are representative of rural Indonesian posts, cross-regional comparative studies across diverse island contexts are recommended.
- **Short Evaluation Window:** Operational metrics were evaluated during immediate post-intervention service sessions. Longitudinal research tracking facility retention, maintenance adherence, and direct child clinical metrics (e.g., multi-year stunting reduction rates) over a 24-to-36-month period is warranted.
- **Self-Reported Qualitative Bias:** Stakeholder feedback and satisfaction ratings may be influenced by social desirability bias toward the research team. Future studies should incorporate independent third-party observational audits to validate self-reported satisfaction figures.

5. Conclusion

This community engagement initiative demonstrates that integrating physical spatial restructuring with participatory capacity building effectively optimizes primary healthcare delivery at *Posyandu Anyer 10* in rural Indonesia [4,6]. By transitioning from an unorganized interior layout to an ergonomically aligned five-table service workflow, the intervention dramatically eliminated administrative delays, reduced setup times by 72.6%, streamlined participant processing times by 52.7%, and expanded dedicated maternal counseling durations by over 200% [4]. Adopting a Participatory Rural Appraisal (PRA) framework fostered high community engagement, successfully mobilizing local resources (*swadaya*) for exterior bamboo fencing and elevating health cadres' overall operational competency from 53.5% to 92.5% [3,10]. Furthermore, securing village government commitment for ongoing maintenance ensures the long-term institutional sustainability of the facility [7]. In conclusion, combining low-cost physical ergonomics with health worker empowerment offers an efficient, scalable, and adaptable model for strengthening community-based primary healthcare governance, improving service quality, and advancing maternal and child health outcomes across rural developing contexts [1,11].

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