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Conceptualizing the implementation of post-discharge malaria chemoprevention in Malawi using a co-design approach

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Abstract

Background Severe malaria poses a significant challenge to under-five children in Malawi, leading to high rates of hospitalization and mortality. The World Health Organization has recently recommended post-discharge malaria chemoprevention (PDMC) as a preventive strategy for under-five children with severe anaemia in malaria-endemic regions. In response to this recommendation, Malawi's Ministry of Health (MoH) plans to implement PDMC nationwide. To facilitate effective implementation, the MoH has partnered with the Training and Research Unit of Excellence (TRUE) to conduct PDMC delivery trials to gather evidence for practical implementation in Malawi and similar settings. A key component of this initiative involved the MoH leading the co-design workshops with key stakeholders to foster collaboration, spur innovation, and develop user-centred strategies. This collaborative effort aimed to investigate optimal PDMC implementation strategies to guide the scale-up in Malawi and contribute to policy-making processes that enhance transparency, accountability, and ownership.

Methods This participatory action research occurred in the Salima district, Malawi, from 11 to 12 May 2023. Two co-design workshops were utilized, involving policymakers (n = 15), healthcare providers (n = 8), and prospective users (n = 2). The approach consisted of two stages. First, separate information-gathering sessions were held with policymakers, healthcare providers, and prospective users. Second, a structured discussion was facilitated, allowing collaboration between policymakers, healthcare providers, and prospective users to develop strategies for delivering and integrating the intervention. Discussions were audio recorded, transcribed verbatim, and manually analyzed using a thematic approach.

Results The inductive analysis yielded four overarching themes from the data. These key themes are PDMC adaptability, trialability, implementability, and sustainability. Stakeholders recommended adopting PDMC in Malawi, with health facilities as the optimal delivery option, ensuring that discharged children receive dihydroartemisinin-piperaquine doses for three months. PDMC aligns with existing systems, offering integration opportunities for managing childhood illnesses. However, gaps in policy development, approval, and health system strengthening—including supply chain, monitoring, evaluation, and follow-up—must be addressed to ensure PDMC's sustainability.

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Conclusions The co-design results indicate stakeholders' willingness to adopt and implement PDMC in Malawi. However, there is an awareness of the challenges that must be addressed to facilitate PDMC's successful implementation and sustainability.

Keywords Co-design, Post-discharge malaria chemoprevention, Post-discharge malaria continuum of care, Dihydroartemisinin piperaquine, Severe malaria, Severe anaemia, Implementation, Malawi, Sub-Saharan Africa

Background

In sub-Saharan Africa, severe anaemia is a leading cause of hospital admissions and paediatric mortality, responsible for 17 to 54% of malaria-attributable deaths [1]. Severe anaemia occurs when the number or functionality of red blood cells is insufficient to meet physiological needs, leaving children, particularly those under five, vulnerable even after hospital discharge [2]. Given this, on June 3, 2022, the World Health Organization (WHO) recommended Post-Discharge Malaria Chemoprevention (PDMC) for the prevention of malaria among under-five children recovering from severe anaemia in malaria-endemic regions [3].

PDMC was proven to reduce mortality and re-admissions among under-five children recently discharged from the hospital by administering long-acting antimalarials at specific intervals, regardless of the child's malaria status. A recent meta-analysis of three double-blind, placebo-controlled PDMC trials involving 3663 children treated for severe anaemia [4]. The results showed that a 3 month PDMC regimen reduced mortality by 77% (95% confidence interval (CI) 30–98%) during the intervention period and reduced all-cause readmissions by 55% (CI 44–64%) six months post-discharge [4].

The trials explored three different drug regimens in various settings: monthly sulfadoxine-pyrimethamine (SP) in The Gambia (average: 3.1 doses per child, N = 1200) [5], monthly artemether-lumefantrine (AL) in Malawi (administered at 4 and 8 weeks post-discharge, N = 1414) [6], and monthly dihydroartemisinin-piperaquine (DP) in Uganda and Kenya (given at the end of the 2nd, 6th, and 10th weeks post-discharge, N = 1049) [2]. Additionally, the meta-analysis reviewed studies on acceptability [7], delivery strategies [8], cost-effectiveness [9], and impact modelling [10] of PDMC.

However, the WHO recommendation does not specify which antimalarial drug and delivery strategy to use for PDMC, suggesting that these decisions should be made nationally and tailored to local contexts. In response, the Ministry of Health (MoH) in Malawi, through the National Malaria Control Programme (NMCP), is considering implementing PDMC nationwide. Determining the most effective, feasible, and sustainable delivery option for the Malawian context remains a crucial challenge.

Involving stakeholders: a co-design approach

In collaboration with the Training and Research Unit of Excellence (TRUE), the MoH conducted two co-design workshops to provide ideas and guidance for implementing PDMC delivery trials. The trial aims to inform the optimal delivery strategies of PDMC in Malawi and similar healthcare settings. The co-design approach, increasingly recognized as a crucial part of implementation science research, involves a collaborative partnership between researchers and stakeholders. This approach is efficient when employing participatory methodologies [11].

Firstly, a co-design approach aims to explore the complexities of study design. It involves researchers and end users working together from the outset, including framing research questions, designing the study, and guiding its execution. Additionally, it incorporates strategies for implementation and broader dissemination from the project's inception [11, 12]. Secondly, integrating the co-design approach in implementation science ensures that plans fit real-world conditions by examining what works, how it works, and why, especially in specific situations [11]. It tests ways to reduce implementation risks, identifies facilitating factors, anticipates results, and designs strategies to scale up interventions within the health system for wider adoption [12]. Thirdly, employing the co-design approach means researchers and community members work together as equal partners. By involving stakeholders, this method tailors research to their needs, enhancing the effectiveness and responsiveness of real-world interventions [12–15].

Co-design workshops engaged the MoH, health policy stakeholders, implementers, and prospective users to explore PDMC delivery strategies in Malawi. Before the workshops, the research group conducted studies that contributed evidence to the WHO, leading to the recommendation of implementating PDMC in all countries in Africa with moderate and high malaria transmission. These efforts supported the co-design of PDMC within Malawi's health system and provided insights into the implementation of medical interventions beyond traditional health institutions. Data from the workshops were systematically analyzed to facilitate decision-making and accountability.

Methods

Study design and setting

Participatory action research (PAR) [16, 17] was used to explore and identify optimal PDMC implementation strategies and to integrate PDMC into existing health service delivery platforms in Malawi. The PAR approach was selected due to its capacity to steer discussions toward actionable outcomes while fostering stakeholder collaboration. The data collection process involved two stages. The first stage consisted of information-gathering sessions with policymakers, healthcare providers, and prospective users held separately. The second stage involved a structured and facilitated discussion in which policymakers, healthcare providers, and prospective users jointly developed strategies for delivering and integrating the intervention. The primary objective of the co-design workshops was to co-develop an action plan for implementing a PDMC trial in Mangochi district, Malawi. A secondary objective was to systematically document the workshop outcomes, including both the substantive decisions made and the context-specific decision-making processes.

The co-design workshops consisted of 25 stakeholders categorized as NMCP team (n = 5), MoH policymakers (n = 3), health systems managers (n = 6), Public Health Institute of Malawi (PHIM) – Public Health Research (PHR) (n = 1), District Health Management Teams (n = 8), and prospective users (n = 2) who were purposively sampled [18, 19]. The co-design workshops were conducted in Salima district from 11–12 May 2023. Salima, a district situated in the central region of Malawi along the shores of Lake Malawi, was selected as the meeting venue due to its strategic central location and excellent road network, making it convenient for workshop participants.

Recruitment and data collection

A list of stakeholders from 11 districts in Malawi — namely, Mangochi, Blantyre, Lilongwe, Dedza, Mwanza, Karonga, Mzimba, Balaka, Ntchisi, Mulanje, and Kasungu —was compiled through the office of the NMCP Manager. The stakeholders were purposively selected with careful consideration given to their professional expertise and the district stratification of the malaria burden in Malawi [20]. This deliberate selection brought together individuals with knowledge, experience, and responsibilities so that they could contribute to the discussion on PDMC implementation. Prioritizing professional qualifications and practical insights ensured that the gathered perspectives would have broad applicability across the health system in Malawi.

The two purposively sampled prospective users were caregivers of under-five children. One came from a difficult-to-reach area in one of the seven districts categorized as a moderate malaria burden stratum [20] and the other came from an urban setting within the highest malaria burden stratum [20]. Given that qualitative research values depth over participant numbers and that the aim was to co-design PDMC through group discussions—not targeting saturation— it was determined that involving two prospective users among healthcare providers was adequate for exploring PDMC delivery strategies in Malawi [21]. However, involving additional participants could have provided a broader range of insights from the user perspective. That said, the value of this information is enhanced by concrete, real-world experiences, which will be explored further after the implementation.

The first author (MKN) personally called each participant to explain the purpose of the workshops and invite them to engage in the discussions. Each discussion group was limited to ten stakeholders, and individuals from the same organization were placed in different groups. This separation helped to avoid power dynamics and pre-established consensus that might hinder open and productive conversations. Additionally, the groups intentionally included a mix of prospective users, health policymakers, programmers, and implementers to ensure diverse experiences and knowledge were represented.

Experienced investigators trained in participatory approaches facilitated the co-design workshops. These facilitators employed strategies to minimize power imbalances, such as setting ground rules for respectful dialogue, ensuring equal speaking opportunities, and actively encouraging contributions from all participants, including quieter or less assertive individuals. By managing these dynamics, the team encouraged an inclusive environment where every voice was valued and heard, regardless of organizational role or status. As a result of these efforts, the discussions provided rich, diverse insights into the topic. This approach achieved the study's objectives without the need for further in-depth interviews.

Data were collected using two pretested question guides (see Additional files 2, 3), which were projected on a wall during group discussions. One guide was designed for policymakers, while the other was intended for healthcare providers and prospective users. The guides were developed in English and pretested with five purposively sampled research staff members to refine the questions for clarity and incorporate additional probes. Two workshops were organized utilizing a PAR approach to collaboratively develop strategies for implementing and integrating the PDMC intervention into the health system delivery. This approach actively engaged stakeholders, ensuring that the developed strategies were grounded in the local context. By emphasizing real-world outcomes

and aiming to effect meaningful change, the process sought to co-create actionable and sustainable plans to drive improvements within the health system. The first workshop had two group discussions in the morning and two in the afternoon (four discussions), each with the same stakeholders. The stakeholders included members of the NMCP Technical Working Group, program officers and all sampled health actors involved in malaria control in Malawi, as well as researchers and representatives from the MoH Directorates of Malaria and Nutrition. The second workshop involved two discussions with District Health Leadership, which included MoH district health staff, nutrition officers, non-governmental healthcare providers, community healthcare program leaders, and prospective users. A total of six discussions were conducted. Researcher and participant reflexivity was prioritized through regular self-reflection during discussions and by facilitating open dialogues about perspectives and experiences, ensuring mutual awareness of biases and assumptions [22].

The group discussions centred on the acceptability of implementing PDMC and the logistics of delivering health services. Acceptability is the perception among implementation stakeholders that a treatment, service, practice, or innovation is agreeable, palatable, or satisfactory [23]. Feasibility is the extent to which a new treatment or innovation can be successfully used or carried out within a given agency or setting [24]. Topics included the integration of PDMC with other healthcare services, its feasibility and appropriateness, the potential public health impact, supply chain challenges such as costs, the roles of health facility staff, and staff training—particularly regarding the enhancement of screening and treatment for anaemia and the administration of PDMC. Additionally, the importance of appropriate medical record-keeping was emphasized.

Data was collected using flip chart notes documenting the barriers, enablers, implementation strategies, and action plans. Discussions were held in English and Chichewa (the national language) and audio-recorded to ensure all details were captured. The discussions lasted 60–95 min. MKN took notes, and KP and LM summarized key points after every discussion as a measure of validation [22]. The process was guided by the consolidated criteria for reporting qualitative research (COREQ) (Additional file 1) [22].

Ethical approval for the protocol, consent documents, and discussion guides was obtained from the College of Medicine Research Ethics Committee (COMREC—P. 01/23/3942). Written informed consent was obtained from stakeholders prior to participation in the group discussions. To ensure confidentiality, participant identity numbers were used in place of names during the discussions. The study was conducted in accordance with the Declaration of Helsinki guidelines and regulations [25].

Data analysis

Recordings were transcribed verbatim in English and manually managed in Microsoft Word. Transcription was done by MKN and reviewed by LMT, who listened to all six recordings. The transcripts were analyzed thematically and inductively to assess the acceptability and feasibility of implementing PDMC in Malawi. MKN familiarized herself with the data set and developed the first codebook through immersion by actively and repeatedly reading the first two transcripts. To ensure the reliability of coding and consistency, LMT checked the codebook for validation by independently reading the first two transcripts while inductively identifying codes related to the adaptability, trialability, implementability, and sustainability of PDMC in the Malawi health system [18]. This collaborative approach not only strengthened the codebook but also enhanced the overall rigour of the analysis. MKN and LMT then regrouped for a final codebook through a consensus process by looking at commonalities and differences to increase confidence in the dependability and trustworthiness of the findings [18, 26, 27]. MKN then manually coded the four remaining transcripts, with feedback from LMT, deleted repeated codes, and added new ones until a final codebook was created. The final codebook was agreed upon by the joint consensus of MKN and LMT [22, 26]. MKN grouped all similar and meaningful excerpts for easy immersion/familiarization with the data through repeated and active reading [28–30]. Finally, MKN and LMT regrouped again and identified relationships between these codes; repeatedly identified codes were merged, and themes were generated from these codes.

Reflexivity

This paper is part of MKN's PhD project. With a background in public health and extensive experience in qualitative research, MKN acknowledges her preconceptions and experiences within the health system in Malawi that may have influenced data collection, coding, and analysis [31]. The research team's work at TRUE, which focuses on malaria, further exposes them to the health system's enablers and barriers to implementing PDMC. These experiences shaped how MKN and LMT analyzed and coded the data without attempting to bracket their own experiences [32, 33].

Recognizing that reality is subjective and can be perceived differently by various agents, MKN and LMT utilized an inductive approach to focus on and illustrate the depth and richness of experiences from both researchers

and participants regarding the feasibility and acceptability of implementing PDMC in the Malawian health system [34]. Their extensive experience in qualitative research informed their analytical perspective and helped direct attention to key themes. By considering positionality and the dynamic process of interpretation, the study's transparency and rigour were strengthened [35]. Reflexivity enhanced understanding and played a crucial role in shaping the interpretation and presentation of the findings.

Results

This section presents the results from two co-design workshops with stakeholders involved in malaria management. The findings were thematically and inductively analyzed, focusing on PDMC adaptability, trialability, implementability, and sustainability. These results highlight critical factors that support or hinder the implementation and delivery of PDMC in Malawi.

PDMC adaptability

Stakeholders highlighted the robust evidence base from other countries as a significant facilitator for adopting PDMC in Malawi. The success stories and data from similar initiatives provided a compelling argument for PDMC's potential effectiveness locally.

> *"Internationally, I think the availability of data from other countries that are also doing the same within our region facilitates the PDMC implementation." - Policymaker, Group A, Male*
> *"If the intervention has worked in other countries, then it would be good to try it in our communities because these under-five children get sick of malaria again and again." – Prospective user, Group A, Male*

However, to align PDMC with the Malawian context, stakeholders suggested renaming the intervention to post-discharge malaria continuum of care (PDMCC). This change aims to avoid conflicts with WHO guidelines and ensures continuity in care from hospital to home settings.

> *"I would choose DP only when it changes the name to say it is not chemoprevention, but we are continuing the care beyond the facility because there is not enough space in the hospital, and we are trying to manage the rest of the risk of further infection, and we are discharging them to continue treatment at home." - Policymaker, Group A, Female*

PDMC trialability

Stakeholders reflected on various issues related to drug choice, procurement costs, supply chain concerns, and considerations that would facilitate the implementation of PDMC in Malawi. Consensus was observed among stakeholders to prioritize high-burden areas [21] for the initial trial of PDMCC, emphasizing strategic resource allocation to maximize impact.

> *"...We need to engage high-burden districts that are making a lot mainly from the central, then one from the south and then one from the north." - Policymaker, Group B, Male*

Stakeholders suggested three potential delivery strategies: health facility administration, community-based distribution via health surveillance assistants (HSAs), and providing caregivers with all necessary doses. However, stakeholders advised that a health facility-based delivery strategy would be more manageable and provide better oversight of medical personnel. This approach addresses concerns about adherence and medication misuse.

> *"... So, I think it is good that after every four weeks, the mother should come and get the next dose, and if it is far from the hospital, they should be kept at the nearest village clinic of this patient." - Healthcare provider, Group B, Male*
> *"I will also go for the health centre strategy to review the child. That's very important. If the child has any adverse effects, it should be seen." - Policymaker, Group A, Male*

The facility-based delivery strategy was also preferred because it would involve direct contact with the healthcare provider, ensuring that drug administration is directly observed to address adherence issues and improve compliance.

> *"When we look at the child who can now play, we might stop giving medication. In this case, going back to the hospital would improve adherence." – Prospective user, Group B, Female*

This approach will also help mitigate the misuse of the medication.

> *"There will be adherence problems to treatment guidelines. Such that they will start using DP as adult treatment for case management. They will not understand that this is meant for chemoprevention...caregivers might not keep DP in a good environment." - Policymaker, Group A, Female*

PDMC implementability

Stakeholders deliberated on the health systems' readiness, compatibility, and conditions for implementing PDMC. The contextual features encompassed the advantages, opportunities, challenges, and concerns

regarding the health system's preparedness to deliver the intervention.

The stakeholders recognized that integrating PDMC into the current health system is feasible. They observed that the community level is notably robust despite its weak infrastructure. This is supported by a skilled health workforce with the experience and knowledge to effectively implement malaria programs and treatment guidelines. This strong foundation is seen as essential for successful implementation.

"I think, despite the weak structures, the experience and lessons we already have can facilitate the implementation." - Policymaker, Group B, Female
"The staff already know malaria management, meaning we will not need many resources for people to start implementing; it is just a matter of briefing. Another thing is that we are supported by partners mostly in malaria issues, and they try that commodities should be available, unlike our drug budget through medical stores." - Healthcare Provider, Group B, Male

An important feature was the relative cost of DP compared to AL. Stakeholders noted that DP was more economical as a first-line and prophylaxis, offering a cost-effective choice as a chemoprevention therapy for children with severe anaemia.

"The annual cost of using DP for prophylaxis and AL for first-line treatment is $12,000, while using DP for both prophylaxis and first-line treatment totals $9,000. This demonstrates that DP is more cost-effective." - Policymaker, Group A, Male.

Furthermore, stakeholders preferred dihydroartemisinin-piperaquine (DP) over artemether-lumefantrine (AL) due to its simpler dosing regimen, which is expected to enhance patient compliance.

"DP has better compliance because of less frequent administration, which can be translated to improved compliance. The other reason for DP is because it is a single dose in a day for three days compared to AL, which is BID (twice a day, in medical terms), which makes DP easy to use." - Policymaker, Group B, Male

Stakeholders were confident about the feasibility and practicality of integrating PDMC into existing community healthcare systems because PDMC fits broadly within malaria control and prevention programmes.

"Nationally, we already have staff for control of programs and community-based staffing systems like volunteers, drug management systems, and monitoring systems/tools… This is an opportunity, and we are not supposed to create a new monitoring and evaluation system for PDMC. We can integrate with what is already available." - Policymaker, Group B, Male

Village clinics provided an opportunity to play a role in supporting the facility-based delivery strategy.

"The availability of functional village clinics is a plus for PDMC. This will work better with the Integrated Management for Childhood Illnesses (IMCI)." -Healthcare provider, Group A, Male.
"Logistic supply chain management systems could be strengthened or adjusted together for this. M&E system, training systems, patient review/follow-up." - Healthcare Provider, Group A, Male

Healthcare providers were particularly concerned about inconsistent drug availability, reflecting on previous experiences with the AL rollout.

"For the supply chain, is there any assurance that supplies will be available on the ground? They can mention that it is in the system, but what we see on the ground is not a good supply chain. At the beginning, when AL was being introduced, it was hard to get it established." - Healthcare provider, Group B, Female

They were also concerned about the increased workload and staff shortages.

"For me, it is the multitasking for the HSAs because everything seems on their shoulders. They are overburdened already, so increasing their workload is a disadvantage." - Policymaker, Group A, Female.
"There could also be a high turnover of staff. The one that was trained in PDMC will be moved to another department, and the one that has replaced the former will say, I do not have an idea about that strategy, and it should be done by those that were trained." - Healthcare Provider, Group B, Female

PDMC sustainability

Adopting a policy involves obtaining government approval, ensuring alignment with WHO recommendations and the National Health Research Agenda, collaborating with stakeholders, developing evidence-based approaches, addressing specific needs, improving health outcomes, ensuring practical implementation, and securing public acceptance. In Malawi, TRUE has been collaborating with key stakeholders within the MoH to produce evidence supporting the adoption of PDMC as a policy. Stakeholders underlined the imperative need for a PDMC

policy to guarantee sustainability. The absence of an approved policy in Malawi poses a significant challenge.

> *"Yes, we are yet to develop the PDMC policy. We are still discussing, and after this workshop, I will go to senior management… when it is approved, then we will have a policy." - Policymaker, Group A, Male*
> *"PDMC is not yet approved as policy in Malawi, which means it is a national challenge." - Policymaker, Group A, Male*

The absence of an approved policy means that obtaining approval to procure medical equipment and supplies from implementing partners and donors will significantly challenge PDMC's sustainability. Stakeholders highlighted potential cost implications associated with adopting PDMC and anticipated the financial challenges.

> *"In the current budget application, even from the Global Fund, there is no funding for PDMC, which is the challenge. The government of Malawi does not provide us with resources; occasionally, they provide us with fuel... as calculated earlier, we need 9 million Malawian Kwacha per year for PDMC. So, the issue now is where to obtain these resources..." - Policymaker, Group A, Male*

The availability of supplies is a bottleneck to sustaining the program's implementation. As one healthcare provider noted:

> *"Availability of resources, such as drugs, should be there, which will help us to get this done. Sometimes, we would want to start implementing while we do not have the drugs." - Healthcare provider, Group B, Male*

Both factors significantly threaten the overall implementation, roll-out, and scaling up of PDMC in Malawi.

Discussion

This study is the first to detail the results of co-designing the implementation of post-discharge malaria chemoprevention (PDMC) in Malawi. The findings elucidate the optimal contextual delivery strategy for PDMC implementation, identify potential facilitators and barriers, and highlight the intervention's acceptability. The inductive approach enabled a comprehensive assessment of the various factors influencing PDMC implementation.

The findings align with previous qualitative research conducted in Malawi, which reported high acceptance of PDMC among caregivers [7]. This alignment suggests that PDMC implementation in Malawi is feasible, provided that specific considerations are addressed. Stakeholders acknowledged PDMC's potential to significantly reduce readmission and mortality rates among children under five in Malawi.

Policymakers strongly advocated for using DP for PDMC, citing its proven efficacy [2], cost-effectiveness [9], acceptability [7], and ease of delivery [8]. Following a stakeholder engagement meeting in Kenya in 2023 [36], Malawi plans to transition from AL to DP as the first-line treatment by 2025. Consequently, DP will be used as a first-line treatment for uncomplicated malaria and chemoprevention, administered at discharge and every four weeks for three months. However, this dual use of DP conflicts with WHO guidelines, which discourage using the same drug for both treatment and chemoprevention [3]. Despite the deviation, Malawi's post-discharge malaria continuum of care (PDMCC) emphasizes the continuous management of the initial severe malaria event that requires hospitalization.

Stakeholders preferred a health facility delivery strategy to enable clinical reviews for children receiving PDMC. This decision, however, contradicts previous findings from a cluster-randomized trial in Malawi, where community-based delivery of AL for PDMC resulted in higher adherence compared to facility-based methods [8]. Additionally, a follow-up study indicated that caregivers favoured a community-based delivery strategy due to easier home access to drugs and fewer financial concerns, raising concerns about the potential impact on adherence and health outcomes [7]. This strategic shift arises from recognized limitations of community-based delivery methods, such as difficulties with medication storage, the risks associated with families sharing medications, and the absence of effective ways to monitor patient health outcomes.

The co-design workshop results aim to inform an implementation trial in the Mangochi district, as recommended by stakeholders, given that it is one of the ten districts categorized within the highest-burden malaria stratum [21]. Children will be randomized to receive PDMCC in two arms as follows: (i) Community-based: the mother will be given all PDMCC courses at discharge from the hospital (intervention arm), (ii) a combination of community-based: The mother requests to get monthly PDMCC supplies from the HSAs who will get all PDMCC drugs at the village clinic level, and facility-based: the mother is asked to return to the health facility for each monthly PDMCC dose (control arm). This will also involve a clinical review of the child and further referral if the child is ill. The targeted outcome is improved adherence. Based on the outcomes of the implementation trial, the study will inform and recommend the optimal delivery strategy to relevant stakeholders in Malawi.

The recommendations will contribute to the development of PDMC policy treatment guidelines to standardize care, ensure accountability, and improve patient outcomes. This policy will enable healthcare providers to deliver high-quality care that meets the needs of under-five children post-discharge. These findings align with other prophylactic services, such as intermittent preventive treatment of malaria during pregnancy with sulfadoxine-pyrimethamine and cotrimoxazole prophylaxis for HIV-positive individuals, where context-specific research evidence fostered policy development ensured successful implementation [37–40]. This underscores the fact that while the WHO guidelines offer valuable direction, developing a context-specific policy is essential for effective execution in real-world settings.

The PDMC innovation is compatible with existing health systems, particularly the Integrated Management of Childhood Illnesses (IMCI) [41], which will positively facilitate its implementation. Nevertheless, potential barriers must be addressed, including poor performance of health surveillance assistants (HSAs), high workload demands, and irregularities in the health system such as weak community structures, supply chain management, monitoring and evaluation systems, poor health-seeking behaviour, and long distances to health facilities. Intense supervision and mentorship have proven effective in similar settings [42, 43]. Increased support from the Ministry of Health for the IMCI programme is recommended to foster a conducive environment for community case management and ensure PDMC sustainability. This support should include ongoing mentorship, training, and supervision to improve service quality and adherence to PDMC.

Implication of the study

Based on the outcomes of the co-design workshop and the contextualization of barriers and facilitators in the Malawian setting, the MoH and TRUE, as stated earlier, plan to conduct delivery trials in the Mangochi district. These trials will involve randomizing children to receive PDMCC in two distinct arms: community-based intervention, where mothers will be given all PDMCC courses at discharge from the hospital, and a combined community-based control, where mothers will request monthly PDMCC doses from Health Surveillance Assistants (HSAs) at the village clinic or from the nearest health facility, including a clinical review of the child and referral if necessary.

These delivery trials, informed by the results of this study, will provide critical evidence on the most effective delivery strategy for PDMCC within the Malawian context. The findings from these trials will be instrumental in shaping the national rollout of the PDMCC intervention. By delivering robust data on the acceptability, fidelity, and feasibility of the two delivery methods, these trials will ensure that the intervention is contextually appropriate and sustainable. This evidence will be pivotal in resolving concerns about adherence and health outcomes associated with different delivery strategies.

Aligning with the IMCI principles and enhancing community health structures will be critical components of this implementation. The results of these trials will not only inform the PDMCC rollout in Malawi. They will also contribute to global health knowledge, particularly in severe anaemia and malaria management. This research underscores the necessity of tailored, evidence-based approaches in public health interventions, ensuring that policies and practices are grounded in the specific needs and contexts of the populations they serve. The trials aim to provide a scalable and sustainable model for PDMCC implementation, ultimately aiming to reduce child mortality and improve health outcomes in malaria-endemic regions [44].

Strengths and limitations

The co-design approach was centred on experienced individuals who provided perspectives relevant to malaria care in Malawi. Their insights were instrumental in informing delivery trials conducted in the Mangochi district. By leveraging the expertise of these knowledgeable participants, a comprehensive understanding of the challenges and opportunities within the malaria landscape was captured, ensuring that the findings are applicable and actionable across diverse contexts. The study involved only two prospective users, and it is acknowledged that individual interviews could offer additional insights into specific issues, particularly those less likely to surface in group settings. Future phases of this work will incorporate individual interviews to deepen understanding and address this limitation. It is also acknowledged that the inclusion of only a few prospective users and the lack of explicit attention to gender diversity represent limitations. Although the group discussions included diverse stakeholders—such as healthcare providers, policymakers, and programme implementers—the limited number of users may have constrained the ability to broadly capture their perspectives, particularly regarding gendered experiences and contextual nuances.

To address this limitation, future research will expand the investigation of users' perspectives on acceptability. This will include a larger and more diverse sample of users, reflecting variations in gender, household roles, and community leadership. Additionally, richer and more actionable insights into acceptability will be sought by exploring these perspectives after users have concrete, real-world experiences with the intervention. While this

study provides a necessary foundation, there is a commitment to building on these findings with a more gender-inclusive and representative approach to improve the generalizability of the results. Finally, while the methodological approach of this study may limit the generalizability of its findings, the insights gained can be effectively applied in other low- and middle-income countries with contexts similar to Malawi's when planning for PDMC implementation and adoption.

Conclusion

This study represents the first effort to co-design the implementation of post-discharge malaria chemoprevention (PDMC) delivery strategies for further testing and evaluation in Malawi. The findings provide valuable insights into optimal delivery strategies for PDMC, identifying potential facilitators and barriers to its implementation. High acceptance of PDMC among caregivers, as demonstrated in previous studies, highlights the feasibility of implementing the intervention in Malawi, provided that critical considerations are addressed. The results from the co-design workshops underscore the importance of tailored, evidence-based approaches in public health interventions. By addressing the specific needs and contexts of the Malawian healthcare system, implementing PDMCC can reduce child mortality, improve health outcomes, and ensure sustainable, long-term benefits for child health in malaria-endemic regions.

Abbreviations

AL	Artemether-lumefantrine;
COMREC	College of Medicine Research Ethics Committee
DP	Dihydroartemisinin-piperaquine
HSA	Health surveillance assistant
IMCI	Integrated management of childhood illnesses
MoH	Ministry of Health
NMCP	National Malaria Control Programme
PDMC	Post-discharge Malaria Chemoprevention
PDMCC	Post-discharge Malaria Continuum of Care
PHIM	Public Health Institute of Malawi
PHR	Public Health Research
SP	Sulfadoxine-pyrimethamine
TRUE	Training and Research Unit of Excellence
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12936-025-05265-1.

Additional file 1. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups.

Additional file 2. Policy maker's engagement workshop topic guide.

Additional file 3. Healthcare providers and users engagement workshop topic guide.

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Author contributions

MKN, LMT, KSP, KB, ILT, IKC, BR, MK, LM, JC, and OMK conceptualized and designed the study. MKN, TNG, TAT, EMM, and KSP collected data. MKN and LMT analysed data. MKN drafted the manuscript. KB, MK, ILT, IKC, KSP, and LMT reviewed the manuscript, provided input, and suggested additions and changes. All authors read and approved the final manuscript.

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Availability of data and materials

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was approved by the Kamuzu University of Health Science's College of Medicine Research Ethics Committee (COMREC) [protocol number P.01/23/3942] on the protocol, consent documents, and discussion guide. We sought support letters from Chikwawa, Phalombe, and Machinga district hospitals. Before the groups were formed for the discussions, written informed consent was obtained from stakeholders. For confidentiality, we used codes instead of participant names during the discussions. This study was conducted following the guidelines and regulations outlined in the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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