

REVIEW ARTICLE

Effectiveness of Malaria Intervention Programmes among Patent Medicine Vendors: A Systematic Review

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ABSTRACT

Poor diagnosis, treatment and prevention practices had characterised Patent Medicine Vendor (PMV) activities in malaria control despite expectations on their contributions to check the menace. Interventions reversing this situation reduces disease burden and legitimise PMV inclusion in basic healthcare delivery. This study seeks to identify and review studies addressing this priority problem. Steps outlined in PRISMA guidelines were adopted to search and conduct reviews via electronic databases. Randomized trials with intervention effects on PMVs were considered and thirteen articles were ultimately reviewed and narratively evaluated. Analysis of search outputs identified intervention types, methods used, sample sizes, intervention periods, knowledge, attitude and practice variables, other outcomes and listing of priority systematic review topics, using pre-determined criteria. All reviewed studies were found to be effective despite adopting different intervention approaches. Furthermore, identifying and prioritizing reviews greatly improves future malaria interventions and results thereof, thereby maximising opportunities to deliver appropriate and evidence-based healthcare.

Keywords: Systematic reviews, Patent Medicine Vendors, Malaria interventions, Knowledge Attitudes and Practices.

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INTRODUCTION

Systematic reviews provide core evidence on which collated and synthesised recommendations in clinical practice and health assessments for policy decisions are usually based. Furthermore, the quality of health care given by health professionals are known to be supported by evidence-based clinical guidelines which are enhanced by effective dissemination of findings and subsequent implementation of strategies [1], which can be achieved through explicit scientifically sound methods to search, appraise and summarize the resulting evidence from the findings of several conducted primary studies which had earlier addressed similar research issues [2].

Patent Medicine Vendors (PMVs) are individuals that usually deal in the stocking and sale of Over-the-Counter (OTC) drugs as well as provision of other basic healthcare services. As such, PMVs are common sources of antimalarial treatment throughout Sub-Saharan Africa and they play a potentially critical role

in the fight against malaria [3]. PMVs do not have a pre-requisite formal pharmacy training but are licensed to sell orthodox pharmaceutical products on a retail basis [4]. Literature has shown that for long there has been disconnections, discontinuity, loop holes and gaps from the recommended guidelines in the practices of PMVs towards malaria recognition, treatment, referral of cases and its prevention practices, and the major challenges in PMV operations being a gross deficiency in proper knowledge, attitudes and practices (KAP) [5 – 10], resulting in substandard practices which has persisted in the backdrop of the menace of the disease. Furthermore, public health concerns due to malaria devastation had urged the WHO to encourage the various malaria endemic countries to empower PMVs to partake in the fight against malaria [11]. This move legitimises the involvement of PMVs in malaria control thereby averting shortages in healthcare manpower. But however, the inclusion of PMVs in malaria containment had so far not improved the malaria situation [5 – 10, 12].

PMVs have a wide range of educational and professional backgrounds, training exposures, requirements for their would-be members and the fact that they are known by different terminologies in the different respective countries they operate, all these factors were considered before embarking on this study. Furthermore, there are many grey areas relevant to public health in the

training and activities of PMV regarding malaria and its intervention studies within the tropics and other affected developing countries that need to be addressed in systematic reviews. This paper identified, assessed and appraised the existing published literature on effective malaria intervention programmes delivered to PMVs, and it also serves to compile and compare the resulting summarised evidence from the various effective strategies implored by the various primary studies which are of benefit to related future studies. In the review, the KAP of PMVs involved in randomised controlled trials (RCTs), their characteristics, methodologies used, locations of study (country), the comparison groups, sample sizes used and other peculiar factors with different studies and the outcomes of studies were assessed in the prioritized review conducted.

MATERIALS AND METHODS

This review study among PMVs on malaria interventions was carried out in accordance to the PRISMA guidelines for systematic reviews. The review of related literature within a ten year period was conducted from 2006 to 2016 which was later expanded to cover fifteen years, and then finally a twenty five year period, from 1991 to 2016. The extension in search periods was due to the relatively few number of publications encountered in relation to the specific search inputs for the initial search conducted. The review was also limited to articles published in the English language and no review protocol was registered prior to the conduct of the review. However, all studies included were studies conducted on PMV that were published in scientific journals involving an intervention program that had led to outcomes being achieved, and the outcomes in all cases had either a control group or an alternative for comparison of effects of intervention (PICO). The search engines used were PubMed, Scopus, Ebscohost Medical Collection, Science Citation Index and Google Scholar in successions and the different search terms entered were a combination of "RCTs" and "PMVs", "RCTs" and "Malaria", "patent medicine vendors interventions", "Malaria interventions", "Patent Medicine Retailers", "Medicine Vendors", "Drug vendors", "Private Medicine Retailers", "KAP studies", "KAP" and "Malaria", "KAP interventions" and "Malaria". The database search was conducted between 2nd and 7th of March 2017 and this search was duplicated to ensure reproducibility. Grey literature were identified through web searches, so also a search from article reference lists was conducted. But no process was initiated to obtain or confirm findings from authors or investigators, only their publications from search engines were considered. Inclusion was made of all articles that presented outcome data on PMV interventions, and many articles were excluded based on the health providers involved such as pharmacists, community health workers and other formal health providers other than PMV. Various search terms were

used due to the diverse names PMVs were identified with in their various regions, subsequently retrieved articles were then scrutinised for randomisation so as to be eligible for the review process. The risk of bias in studies with unclear randomisation were assessed using a 9-point rigour scale for assessing studies developed by the WHO-Johns Hopkins Synthesizing Intervention Effectiveness Project.

PubMed was the first search engine to be used, whereby the search and identification of articles started by feeding in the key search terms successively and identifying relevant studies from those displayed. The identified and selected articles led to several relevant articles through the 'similar articles search' and the 'search via references' buttons which were also selected for the review and subsequent inclusion. All the identified relevant articles that were displayed from the procedure described above were then selected and pasted on a clipboard. This same procedure was repeated for other search engines, with adjustments and changes in search terms, and subsequently the search was done via all other search engines in the same manner. At the end of the search, 68 articles were identified and sent to the clipboard. To meet the assessment and eligibility criteria, articles had to report PMV level outcome of an intervention, and the subject matter also had to be malaria studies. The screening of articles from titles was followed by screening from abstracts, and subsequently followed by assessment for eligibility to identify articles for inclusion in the review.

Adequate reporting of findings of studies was conducted to ensure internal validity and minimise biases due to selection of studies, since primary investigators were not contacted for details of reports or further explanations. Furthermore, adherence to study design and hypotheses were used to assess risk of bias of selected studies as outlined in PICOS with all participants being registered PMVs, the type of interventions carried out, the comparison employed, the grading of successes of intervention and the time frame of studies all being considered.

RESULTS

Figure 1.0 describes the PRISMA study search and selection process. The number of articles were initially reduced by the exclusion of 23 articles that were found to be irrelevant to the review in focus, so also were articles that involved other health professionals in malaria studies other than PMVs. Furthermore, 16 articles were found to be duplicates, which were replicated due to the use of a range of search terms and subsequently search engines. The 29 remaining articles were then subjected to further screening for the selection process and 11 more articles were further dropped because some were found to be non-intervention based studies

with clearly defined outcomes, while others were found to cover other diseases in PMV interventions aside from malaria. Furthermore, the remaining 18 articles were then selected and subsequently assessed for eligibility in which process five additional articles were dropped because they lacked eligibility in the nature of studies conducted, while some PMV studies were qualitative in nature, finally 13 studies were considered for the review. The process was repeated and same results were obtained. The process of assessment and sorting of the search results and selection of articles reduced the number of articles successively from an initial 68 to a final 13 articles. Tables 1-4 shows a list of reviewed studies which includes focus area of educational intervention, country of the study, type of comparison groups and sample sizes, data collection methods used, socio-demographic characteristics of PMVs assessed, KAP variables assessed, other peculiar factors assessed, outcomes of studies and the overall effect of studies.

Educational Intervention type: Tables 1-4 shows that educational intervention types vary in all studies depending on focus of the intervention training conducted. But all 13 studies had interventions relating to respondents knowledge of drugs and treatment practices with different approaches employed. Referral of patients was incorporated in two studies [9, 10], while interpretation of prescriptions was conducted in two studies [10, 23], appropriate stocking patterns was involved in one study [22], cost implications and drug selection with reference to utilization of recommended

antimalarials was the focus in two studies [19, 20], correct signs and symptoms was covered in one study [9] and rapid diagnostic tests for malaria was covered in one study [18].

Location of studies: Study locations differed for the various reviewed studies and the search results included studies conducted in all malaria infested regions of the world. In all articles reviewed, six were conducted in Nigeria [9, 10, 15, 17, 18 and 23] five in Kenya [8, 19 – 22] and one each conducted at Pakistan [14] and Tanzania [16].

Methodology: Seven studies [8, 14, 16, 18, 20, 22 and 23] had a methodology set-up involving both an intervention and control groups while the six others [9, 10, 15, 17, 19 and 21] had only one group and thereby assessment was based only on the intervention groups' performances. Sample sizes of the reviewed studies ranged from the least number of respondents in a study with 16 respondents [9], to that with highest number of respondents with 319 respondents [19]. In other reviewed studies, respondent numbers were 40 respondents [16], 49 respondents [23], 55 respondents [10], 73 respondents [22], 80 respondents [15], 96 respondents [17 – 18], and 118 respondents [14]. Three studies [8, 20 – 21] had not clearly stated number of respondents used for the study, the researchers considered towns within the study area in clusters forms involving all PMV within the clusters. Blinding was involved in six studies but was elaborately explained in only one study

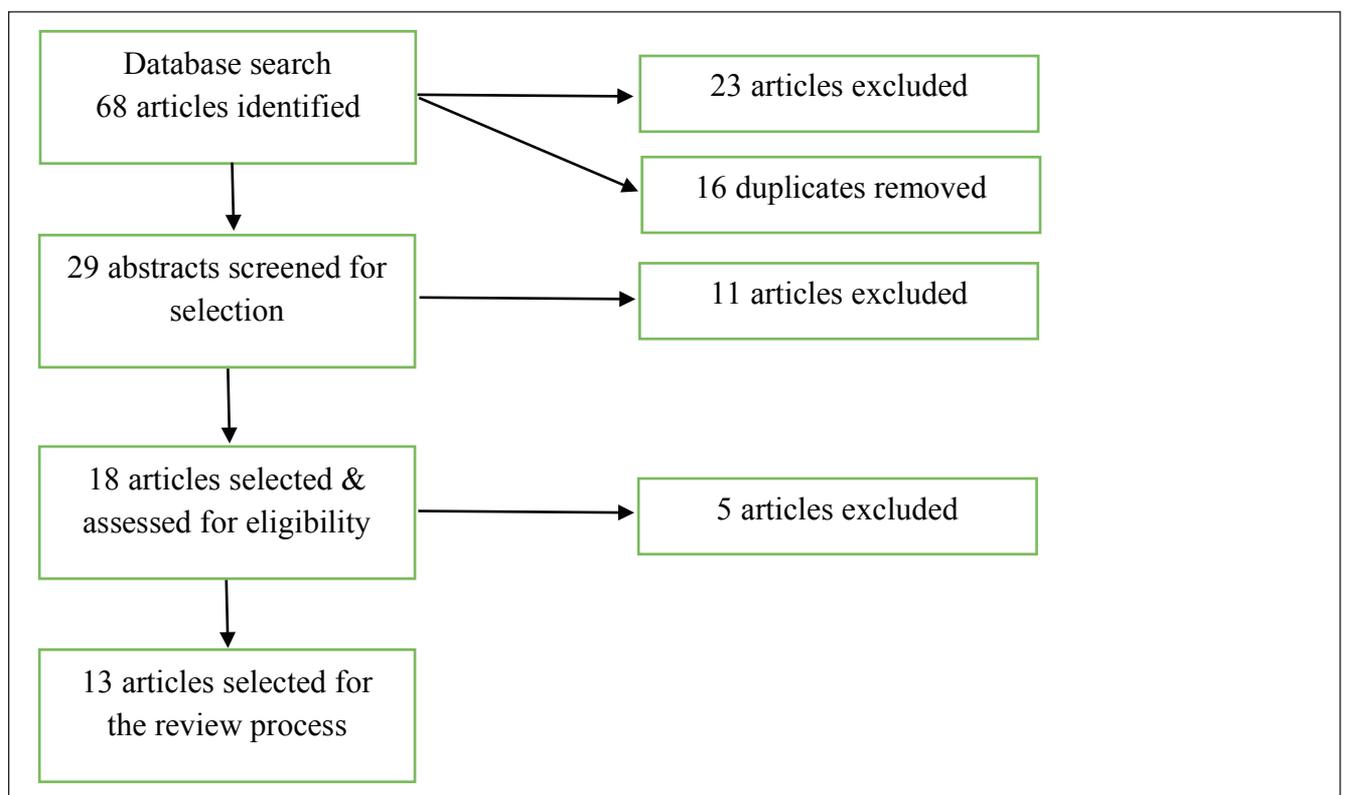


Fig. 1 : PRISMA search & selection flow diagram

Table 1. Reviewed studies

Study	Hussain et al., 2013	Chukwuocha et al., 2013	Nsimba, S. E., 2007
Education intervention	Evaluate the impact of training on knowledge of drugs & dispensing practices	Knowledge and perception on Artemisinin-Based Combination Therapy (ACT) in Malaria treatment.	Intervention aimed at improving management of malaria. To evaluate short term effects of a one-to-one educational intervention approach.
Location of study	Pakistan	Nigeria	Tanzania
Comparison group(s) and Sample Size	Pre / Post. 118 respondents recruited and randomised into 2 groups.	80 randomly selected and consenting respondents.	Only 40 respondents recruited. Randomised into intervention and control groups.
Methodology	A blinded intervention / control group formed via a randomized, controlled, blinded intervention study, designed and implemented.	A randomised cross sectional study was designed.	A one-to-one educational intervention approach in order to improve performance and compliance in using national treatment guidelines. Assessment was after 8 months.
PMV Socio-demographic characteristics assessed	Age	X	√
	Gender	√	√
	Educ level	√	√
	Work Exp	√	X
	Training Experience	√	X
KAP Variables Assessed	Knowledge	√	√
	Attitudes	X	X
	Practice	X	√
Other factors assessed	Included demographics & personal information, status, experience, in service training, views and problems about profession and suggestions for improvement.	Perceptions of PMVs on ACTs as first line treatment for malaria and its implication for compliance with current malarial treatment protocols.	Proper dispensing of drugs, making correct labelling and give correct instructions on how to administer drugs to customers. Also knowledge and drug prescribing / dispensing practices of antimalarials.
Outcomes	Significant difference between the pre-post intervention groups, none was observed in control groups.	Awareness on ACTs improved. Result showed no significant relationship between knowledge and both educational attainment or years of experience.	Significant impact (90%) on knowledge pattern for prescribing and dispensing practices.
Overall Effects of Intervention	Positive effect	Positive effect	Positive effect

√ = assessment of the variable was conducted in the study

X = assessment of the variable was not conducted in the study

Table 2. Reviewed studiescontinued

Study	Awodele, et al., 2012	Abuya et al., 2009	FHS, 2014
Education intervention	Aimed at determining & improving knowledge on Pharmacovigilance (PVG) and adverse drug reaction (ADR) reporting system.	Assessing small-scale interventions on training medicine retailers on malaria treatment. Program was aimed at assessing and improving on the preferred drugs for malaria treatment.	Strengthening PMV Association for Improved Malaria management. Improving PPMVs' malaria testing and treatment by association members.
Location of study	Nigeria	Kenya.	Nigeria
Comparison group(s) and Sample Size	A pre / post assessment with 96 respondents, all were trained and assessed.	Pre / post assessment, with intervention & control groups. Sample size calculated as clusters.	A pre and post with 96 respondents selected from 2 LGs and assigned to groups. Sample size calculated clearly.
Methodology	A randomised cross sectional study, surveys conducted for only the intervention group, no control group. Self-administered questionnaires used.	A cluster randomized trial conducted across 10 administrative divisions and 3 districts. With 2 intervention, 2 controls in 2 districts and 5 intervention & 5 control clusters in 3 rd district, assessed between 3 – 8 months. The study was powered to show a 20% difference between control and intervention. Surrogate clients were used to assess practice.	Cluster randomized trial conducted in 2 LGs of 2 selected states. Two LGs selected in two states and randomly assigned to 2 groups (Int & control). Intervention conducted on LG clusters, via the PMV associations. Client exit interviews were used to assess practice.
PMV Socio-demographic characteristics assessed	Age	√	√
	Gender	√	√
	Educ level	X	√
	Work Exp	√	X
	Training Experience	X	X
KAP Variables Assessed	Knowledge	√	√
	Attitudes	X	√
	Practice	X	√
Other factors assessed	Levels of education	Retail audits used to collect information on general characteristics of the outlets.	Use of RDTs and treated bed nets. Characteristics of PMVs associations. Community perceptions of malaria testing and treatment in PMV shops. Demographics (training/ education, registration, and experience), drugs stocks, malaria knowledge, record-keeping, and methods of improving PMV malaria testing using Rapid Diagnostic Test kits (RDTs) & treatment practices was collected using the PMV knowledge survey and drug audit tool.
Outcomes	Significant improvements in knowledge.	Significant increase in knowledge & practice.	Significant improvements in knowledge, attitudes & practice and use of RDTs.
Overall Effects of Intervention	Positive effect	Positive effect	Positive effect

√ = assessment of the variable was conducted in the study

X = assessment of the variable was not conducted in the study

Table 3. Reviewed studiescontinued

Study	Goodman et al., 2006	Livinus et al., 2009	Abuya et al., 2010	
Education intervention	A Cost-effective shopkeeper training for improving malaria home management	Influence of training on community malaria treatment & practices	Evaluating different dimensions of Programme Effectiveness for PMV Malaria control Intervention	
Location of study	Kenya	Nigeria	Kenya	
Comparison group(s) and Sample Size	319 PMVs selected and trained.	55 randomly selected PMVs through a multistage sampling technique. Baseline data taken & compared with post training data.	Study was in two selected study locations assigned as intervention & control. Sample sizes and randomisation were not clear.	
Methodology	Randomized cluster samples were formed. Job aids, such as charts and rubber stamps given to the PMVs. Treatment of malaria for children between 6 months – 10 years was targeted. 2 main components of intervention: Educational workshop training for drug retailers & community information activities.	Interviewer-administered questionnaire was used to collect data. Simulated visit as mystery client survey which involved direct observation of PMV practice was conducted after intervention and results compared with self-reported post intervention practices.	Mixed quantitative methods used including retail audits and surrogate client surveys based on post-intervention cross-sectional surveys in intervention and control areas Sample size not clearly defined	
PMV Socio-demographic characteristics assessed	Age	X	√	X
	Gender	X	X	X
	Educ level	√	√	X
	Work Exp	X	√	X
	Training Experience	X	√	X
KAP Variables Assessed	Knowledge	√	√	√
	Attitudes	√	X	√
	Practice	√	√	√
Other factors assessed	Assessment of childhood fevers were conducted to assess reduction in infections. Cost of treatment also assessed.	Treatment patterns, attitudes towards referrals & towards alterations of prescriptions, negative practices identified and addressed	Selling prices and utilization of recommended antimalarials, number of health facilities & PMVs in study areas, ratio of facilities to population.	
Outcomes	Proportion of clients receiving recommended antimalarial rose significantly. Cost of treatment reduced drastically and training cost estimated.	Overall appropriate treatment practice score rose from baseline value of 3.6% to 45.5% (p<0.01). However, direct observation of treatment through mystery client survey showed no improvement. So gaps persisted between knowledge and practice.	Evaluation shows a significant impact on PMV knowledge and practices in Intervention area 60.5% of trained compared to 2.8% of untrained ones in terms of knowledge & practices.	
Overall Effects of Intervention	Positive Effect	Positive Effect	Positive Effect	

√ = assessment of the variable was conducted in the study
 X = assessment of the variable was not conducted in the study

Table 4. Reviewed studiescontinued

Study	Marsh et al., 2004	Okeke & Uzochukwu, 2009	Tavrow et al., 2003	Oshiname & Brieger, 1992
Education intervention	Training to improve malaria home treatment.	To determine feasibility & impact of training rural PMVs in Improving childhood malaria treatment & Referral Practices.	Vendor-to-vendor education to improve malaria treatment by private drug outlets.	Primary care training for patent medicine vendors in rural community
Location of study	Kenya	Nigeria	Kenya	Nigeria
Comparison group(s) and Sample Size	Sample size determination was not clearly stated. No control set up.	16 PMVs, lacked comparison group	73 PMVs trained, compared to control group in a pre / post assessment	49 selected. Pre / post-test used. A control group available in another town in the same district.
Methodology	Design to fit Kenya. Lack of randomization & replication. Used participatory skill-based methods for groups of 15–20, also role-play, posters, demonstration, practising, & small group discussions & exercises. Household surveys & simulated retail client used to assess.	A drug vendor-training programme lacking in randomisation. PMVs trained and monitored for 8 months. Measurement of changes in drug vendor practice and knowledge using exit interviews. In addition, home visits were conducted to measure compliance with referral.	73 mobile vendors / wholesalers trained and they in turn trained outlet owners. 255 outlets were then evaluated after 6 months. In the first six months, it is estimated that 500 outlets were reached	Thirty-seven PMV members and their apprentices underwent the 8 weekly 2-hr sessions. Knowledge of other diseases such as TB diarrhoea, guinea worm, sexually transmitted diseases, respiratory infections, and malnutrition also assessed
PMV Socio-demographic characteristics assessed	Age X Gender X Educ level √ Work Exp X Training Experience X	√ √ √ X √	X √ √ X X	√ √ √ X X
KAP Variables Assessed	Knowledge √ Attitudes X Practice √	√ X √	√ X √	√ X √
Other factors assessed	-	Correct signs / symptoms	Stocking patterns,	Interpretation of prescriptions.
Outcomes	Significant improvement in knowledge & drug selling practice (1 – 28%). The proportion of OTC anti-malarial drug users receiving an adequate dose rose from 8% to 33% in 1yr & to 64% in 2yrs.	Major improvements in drug selling & referral practice (80% compliance) & knowledge. Exit interviews confirmed sig increases in appropriate anti-malarial drug dispensing, correct history questions asked & advice given. Study shows training PMVs, as means of reaching community is feasible and strongly supports inclusion in malaria control strategies.	Significant impact on malaria knowledge and prescribing practices. About 32% prescribed 1st line drugs compared to as compared to only 3% of the control shops	significantly higher at post-test and also showed significant gains over a control group of PMVs
Overall Effects of Intervention	Positive Effect	Positive Effect	Positive Effect	Positive Effect

√ = assessment of the variable was conducted in the study
X = assessment of the variable was not conducted in the study

[14]. Different modes of intervention were used by the different studies ranging from a one-to-one educational approach [16] using local guidelines to the use of job aids, such as charts, pictures and lectures given to the PMVs respondents. Other methods used includes demonstrations, role plays, small group discussions and group exercises. Self-administered questionnaires, interviewer administered questionnaires, client exit interviews, simulated visits as mystery clients were used to assess respondents in the reviewed studies.

PMV Socio-demographic characteristics: Researchers in the reviewed studies evaluated different characteristics of PMVs. Age was evaluated by seven studies [8 – 10, 16 – 18, 23], while six studies did not evaluate age [14 – 15, 19 – 22]. Gender was evaluated by nine studies [8 – 9, 14 – 18, 22 – 23], while four studies did not evaluate respondents ages [10, 19, 20 – 21]. Educational levels of respondents were evaluated by eleven studies [8 – 10, 14 – 16, 18 – 19, 21 – 23], while two studies did not [17, 20]. Working experiences of respondents was assessed by five studies [10, 14 – 14, 17 – 18] and training experience was assessed by six studies [8 – 10, 15 – 16, 18].

KAP variables assessed: Knowledge of respondents was assessed by all the studies reviewed, while only three studies assessed attitudes of respondents [10, 18 – 19], and eleven studies assessed practices of respondents [8 – 10, 15 – 16, 18 – 23] while only two studies did not assess practice of respondents [14, 17].

Time frame of studies: Study period in the reviewed studies varied considerably from 3 weeks [10], 8 weeks [23], 6 months [22], 3 – 8 months [8], and 8 months [9, 16]. Other reviewed studies [14 – 15, 17 – 21] were not specific with time frame.

Other variables assessed: The reviewed studies assessed other variables which were peculiar to specific studies. These include personal information and suggestions from respondents for improvements on training and practice, perceptions on the artemisinin combination drugs as first line malaria treatment, giving correct instructions and labelling of drugs, signs and symptoms of malaria, referral of malaria cases, the use of diagnostics tests to confirm cases of malaria, community perceptions of PMV practices, improvement in PMV association activities, pricing and recommended antimalarial use, stocking patterns and prescription handling.

Outcomes and overall effect of intervention: The outcomes of the various studies reviewed ranged from significant differences between pre and post intervention or between intervention and control groups, to an observed marked improvements in number of surrogate / mystery clients receiving the recommended treatments, and significant improvement in KAP of respondents. The

overall effects of intervention in all reviewed studies was a positive effect.

DISCUSSION

Results displayed in Tables 1-4 identified articles that presented outcome data on PMV studies and the selection process screened out all articles involving malaria interventions that were aimed at other cadres of health professionals, and also studies that were PMV based but not involving an intervention of any kind and those with focus on other diseases. The review revealed studies that were not limited to any one geographical region, but was broad and included studies from all regions of the world that were devastated by the menace of malaria.

A form of educational intervention was conducted in all the reviewed studies either as a training, workshops or a skills acquisition exercises at a point to the respondent PMVs, and the effects of such interventions were in all cases assessed at the end of each reviewed study producing an effective outcome on the respondents. Furthermore, in all the articles reviewed, six were conducted in Nigeria, five in Kenya, and one each conducted at Pakistan and Tanzania, thereby involving all studies with specific inclusion criteria from all malaria regions worldwide.

Methodology and sample sizes: This review observed that different methodologies were used in all the different studies reviewed, and methods were adjusted to suite the studies in hand and geographical factors of study locations. Sample sizes employed by the reviewed articles varied from a minimum sample size of 16 respondents [9] to 319 PMV respondents [19]. The sample sizes of respondents used by each study were compared to identify if a standard method was used to determine the number of respondents recruited in each study, it was found that only six studies explained sample size determination in details.

Randomization and study set-up: Randomization was conducted and explained in details in eight studies while five studies either had not conducted or not reported the randomization process adequately. Seven studies had a study set-up involving both an intervention and control groups while the six others had only one group and thereby assessment was based only on the intervention group with respect of their baseline performances. Furthermore, all the 13 studies reported a pre / post assessments with different approaches to assessments which includes: self-administered and interviewer administered questionnaires, retail audits, surrogate client surveys, and simulated visits or exit interviews as mystery client surveys were all used to assess different variables in the different studies. Seven studies had a control set-up in place and six of these seven studies had blinding conducted between the intervention and

control set-ups, while one had no blinding. Six studies compared the pre and post results of only the intervention group that was recruited as a way of assessment.

Socio-demographic factors: PMV socio-demographic characteristics assessed by the various studies were considered and they include age, gender, educational attainment, work experience, and training experiences. It was observed that some studies assessed the respondents for some of these characteristics while others did not, depending on the objective of the studies. In all studies reviewed with gender characteristics stated, a large disparity was noted in the gender compositions with preponderance of males over females, this may be as a result of some restriction of outdoor activities for the feminine gender in some cultural settings in developing countries. Eleven studies reported on PMVs level of education, the percentage of respondents with secondary school education ranged from 22.5% [15] to over 85% [10]. Only two studies [16, 18] specified tertiary level education and professional training of respondents whereas two studies [17, 20] did not report levels of respondent's education. A study that evaluate short term effects of a one-to-one educational intervention approach on PMVs [16] observed that neither educational levels, age, nor gender influenced the knowledge and practice of respondents. This fact was supported by another study [15] where it was observed that no significant relationship existed between the knowledge of respondents and either educational attainment or the years of experiences of respondent PMVs. However, one study [10] made a contrary observation stating that the poor educational background of some PMVs will negatively affect comprehension of all the training contents, thereby derailing the essence of the training program.

Knowledge, attitude and practice assessment: KAP variables assessed in the reviewed studies included assessment of knowledge of respondents by all 13 studies. Knowledge was thus a major variable that was assessed, but considering the heterogenic pattern of how knowledge was measured across the various reviewed studies, it was not possible to use a standard definition or rating for the various studies because the knowledge indicators were not comparable across all the studies. In this respect, seven studies concentrated on knowledge of the different modes of treatments of malaria [8, 10, 14 - 16, 19 and 22], however treatment patterns and the drugs used also differ between countries and regions (due to the different sensitivities of the different malaria species and their respective target vectors), resulting in different approaches in the focus of each study's training. Furthermore, five studies [9, 18, 20, 21, and 23] had different interventions to improve knowledge in malaria control and its prevention, while one study [17] trained their respondents on Pharmacovigilance in malaria treatment. The general inference of all the

studies on knowledge was that knowledge was poor before intervention, and in all cases, the chosen mode of intervention significantly improved the knowledge of respondents.

The attitude variable were assessed by only three studies [10, 18 and 19] and these studies had interest for attitudes of respondent PMVs on the new treatment drugs and their dosage regimens, referrals of severe complicated cases, record-keeping, methods of improving PMV malaria testing using Rapid Diagnostic Test kits (RDTs), the attitudes of PMVs towards the cost effectiveness of treatments and the alteration of prescriptions on malaria treatments. As with the knowledge variable in all studies, attitudes were poor at baseline for all the studies and it significantly improved as a result of the intervention conducted.

Assessment of practice was conducted by 11 studies [8 - 10, 15, 16, 18 - 23] with varying interests in practices relating to malaria ranging from use of the preferred first line drugs for malaria treatment (depending on regional sensitivities), the practices in treating and dispensing the various malaria medications, PMV - client interactions, appropriate diagnosis of malaria with respect to other diseases presenting similar symptoms, timely referral of complicated cases, prevention of malaria and compliance to legal requirements. As was observed with knowledge and attitudes in all the reviewed studies, the findings on practices also had a range of different inferences, and they generally indicated poor practices of the respondent PMVs and in all studies the practice of respondents significantly improved after intervention. Observations of baseline PMV practices indicated that the majority of antimalarial drugs being recommended and the instructions and advice given were mostly of a non-recommended and no more effective nature, and therefore PMV treatment and preventive approach were still considered as ineffective [24] prior to intervention. Overall outcomes: The outcomes of the reviewed studies also varied in their nature depending on the objectives of the different studies, the nature of interventions carried out and the types of assessments conducted. Outcomes included significant improvements and awareness on ACTs, improved knowledge on drug prescriptions and dispensing for malaria treatments, significant improvements in knowledge, attitudes and practices of diagnosis, referrals, appropriate treatment / dispensing patterns, effective use of RDTs and improvement in malaria prevention strategies. Other outcomes include learning techniques to tackle childhood fevers in malaria, improvement in the poor selling practices of PMVs, increase in proportion of clients receiving recommended antimalarials, improvement in the interpretation of prescriptions from higher levels of healthcare, better stocking patterns of PMV shops, correct history questions asked by PMVs and better advice given to clients.

Limitations: This study limited itself to RCTs involving PMVs on malaria, thereby does not consider other aspects of PMV practices as well as non-randomized studies involving the PMVs. Further limitations do exist due to bias at outcome levels of the various studies and some studies were not very clear in describing sample size determination, methodology, comparison groups and levels of assessment of variables.

Follow-up on training: The training sessions in all studies reviewed did not involve a booster session or follow-up training at a point afterwards, the strategy of conducting an additional booster session is one which if considered will reinforce learning and thereby consolidate the gains of the intervention conducted. Furthermore, long term assessments of effect of intervention on the respondents were conducted in only three studies [8, 9 and 16] where a follow up of three to eight months was conducted and the additional effort proved to be useful by further assessing if respondents were still up to date with their newly acquired knowledge and skills.

CONCLUSION

The effectiveness of all thirteen studies assessed in this review was established from the review and findings indicates that there are great opportunities through training to improve the quality of a hitherto poor PMV contribution in malaria control. This also proves that training of PMVs as means of reaching the wider communities are feasible and effective strategies. A combination of different training strategies to fit prevailing training interventions will further result in a more beneficial effects of reversing the deplorable situation of PMV, reduce malaria disease burden and further legitimize PMV inclusion in delivering basic healthcare. The positive effects realized in different training programs will afford PMVs the opportunity to make a headway in eradicating malaria via the exploitation of their hugely untapped potential earned by their numerous untrained members that have already established a close-to-client infrastructure. Future studies can adopt a wider review of the services provided by PMVs not specific to malaria and evaluate the strategies so as to improve services.

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