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Determining approaches to 0ptimize the effectiveness of primary prevention interventions in rural cameroon: integrating the Socio-Ecological Model, diffusion of theory, and the re-aim framework

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ABSTRACT

Despite the proven effectiveness of primary prevention interventions, their implementation in rural areas of low- and middle-income countries often falls short of expected outcomes. This article addresses the third specific objective of a broader HDR research project: to determine the approaches that have been implemented to optimize the effectiveness of primary prevention interventions in rural areas of Cameroon, with particular attention to the Mbalmayo health district.

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Drawing on the Socio-Ecological Model (Bronfenbrenner, 1979; McLeroy et al., 1988), the Diffusion of Innovations Theory (Rogers, 1962, 2003), and the RE-AIM Framework (Glasgow, Vogt, & Boles, 1999), the research synthesizes the literature on effective implementation strategies for primary prevention in rural African contexts. The analysis reveals that effective approaches operate at multiple levels: individual (tailored education, behavior change communication), interpersonal (peer education, family engagement), community (community mobilization, participatory planning, engagement of traditional leaders), organizational (health system strengthening, integration into routine services), and policy (intersectoral action, resource allocation). The RE-AIM framework is identified as the tool par excellence for evaluating whether interventions reach vulnerable populations, achieve their intended effects, are adopted by implementing organizations, are implemented with fidelity, and are maintained over time. The article concludes that optimizing the effectiveness of primary prevention interventions in rural Cameroon requires a multi-level, participatory, and contextually adapted approach.

Keywords: Primary prevention, implementation science, Socio-Ecological Model, Diffusion of Innovations, RE-AIM, rural Cameroon.

RÉSUMÉ

Malgré l'efficacité prouvée des interventions de prévention primaire, leur mise en œuvre dans les zones rurales des pays à faible et moyen revenu n'atteint souvent pas les résultats attendus. Cet article répond au troisième objectif spécifique d'un projet de recherche HDR plus large : déterminer les approches mises en place pour optimiser l'efficacité des interventions de prévention primaire en milieu rural au Cameroun, avec une attention particulière au district sanitaire de Mbalmayo. S'appuyant sur le modèle socio-écologique (Bronfenbrenner, 1979; McLeroy et al., 1988), la théorie de la diffusion de l'innovation (Rogers, 1962, 2003) et le cadre RE-AIM (Glasgow, Vogt, & Boles, 1999), la recherche synthétise la littérature sur les stratégies de mise en œuvre efficaces pour la prévention primaire dans les contextes ruraux africains. L'analyse révèle que les approches efficaces opèrent à plusieurs niveaux : individuel (éducation adaptée, communication pour le changement de comportement), interpersonnel (éducation par les pairs, engagement familial), communautaire (mobilisation communautaire, planification participative, engagement des leaders traditionnels), organisationnel (renforcement du système de santé, intégration dans les services de

routine) et politique (action intersectorielle, allocation des ressources). Le cadre RE-AIM est identifié comme l'outil par excellence qui permet de vérifier si les interventions atteignent les populations vulnérables, atteignent leurs effets attendus, sont adoptées par les organisations de mise en œuvre, sont mises en œuvre avec fidélité et sont maintenues dans le temps. L'article conclut que l'optimisation de l'efficacité des interventions de prévention primaire en milieu rural au Cameroun nécessite une approche multi-niveaux, participative et contextuellement adaptée.

Mots-clés : Prévention primaire, science de la mise en œuvre, modèle socio-écologique, diffusion de l'innovation, RE-AIM, Cameroun rural.

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Despite the proven effectiveness of primary prevention interventions—vaccination, hygiene promotion, health education, and other interventions that prevent disease before it occurs—their implementation in rural areas of low- and middle-income countries often falls short of expected outcomes. A technically sound intervention may be poorly adopted by target populations, implemented with low fidelity, or not sustained over time. These implementation failures represent a significant waste of resources and, more importantly, a missed opportunity to improve population health.

The field of implementation science has emerged to address this gap, focusing on the methods and strategies that promote the adoption, implementation, and sustainment of evidence-based interventions in real-world settings (Eccles & Mittman, 2006; Damschroder et al., 2009). Implementation science recognizes that the effectiveness of an intervention depends not only on its technical properties but also on the context in which it is implemented and the strategies used to support implementation.

In the Mbalmayo health district of Cameroon, primary prevention interventions have been implemented with varying degrees of success. Understanding the approaches that have been used to optimize effectiveness, and identifying which approaches are most promising for future implementation, is essential for improving population health.

This article addresses the third specific objective of a broader HDR research project: to determine the approaches that have been implemented to optimize the effectiveness of primary prevention interventions in rural areas of Cameroon, with particular attention to the Mbalmayo health district. The article is organized as follows. Section two presents the comprehensive theoretical framework, drawing on the Socio-Ecological Model, Diffusion of Innovations Theory, and the RE-AIM Framework. Section three reviews the empirical literature on effective implementation strategies for primary prevention in rural African contexts. Section four synthesizes the findings and identifies key approaches. Section five discusses the application of the RE-AIM framework for evaluating interventions. Section six concludes with recommendations for practice and future research.

2. THEORETICAL FRAMEWORK

2.1 The Socio-Ecological Model

The Socio-Ecological Model (SEM), developed by Bronfenbrenner (1979) and adapted to health promotion by McLeroy and colleagues (1988), provides a framework for understanding the multiple levels of influence on health behaviors and outcomes. The model identifies five levels of influence that must be addressed to achieve sustained behavior change.

The intrapersonal level refers to individual characteristics that influence behavior, including knowledge, attitudes, skills, self-efficacy, and motivation. Interventions at this level typically focus on education, training, and communication to change individual beliefs and behaviors.

The interpersonal level refers to social networks and relationships that influence behavior, including family, friends, peers, and other social contacts. Interventions at this level typically focus on peer education, social support, and family engagement to leverage social influence.

The organizational level refers to the formal and informal rules, norms, and structures of organizations that influence behavior, including schools, workplaces, health facilities, and community organizations. Interventions at this level typically focus on organizational change, including training of staff, changes to policies and procedures, and integration of prevention into routine services.

The community level refers to the relationships among organizations, institutions, and informal networks within a defined geographic area. Interventions at this level typically focus on community mobilization, participatory planning, engagement of community leaders, and changes to community norms.

The public policy level refers to local, regional, and national policies that influence behavior, including laws, regulations, and resource allocation. Interventions at this level typically focus on advocacy, policy change, and intersectoral action.

The SEM is particularly useful for understanding primary prevention in rural contexts, where individual behaviors are shaped by family dynamics, community norms, organizational resources, and public policies. The model highlights that interventions targeting only the individual level are unlikely to be effective if they do not also address higher-level influences (McLeroy et al., 1988; Stokols, 1996).

2.2 Diffusion of Innovations Theory

Diffusion of Innovations Theory, developed by Everett Rogers (1962, 2003), provides a framework for understanding how new ideas, practices, and technologies spread through populations. The theory identifies key elements that influence the diffusion process: the innovation itself, communication channels, time, and the social system.

The innovation's characteristics influence its rate of adoption. Rogers identified five attributes that affect adoption: relative advantage (the degree to which an innovation is perceived as better than what it replaces), compatibility (the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs), complexity (the degree to which an innovation is perceived as difficult to understand and use), trialability (the degree to which an innovation can be

experimented with on a limited basis), and observability (the degree to which the results of an innovation are visible to others).

Communication channels influence how information about innovations spreads. Mass media are effective for creating awareness, while interpersonal channels are more effective for persuasion and adoption, particularly when the communicator shares similar characteristics with the potential adopter.

Time is an important element of the diffusion process. The adoption of innovations follows an S-shaped curve, with slow initial adoption, followed by rapid adoption as a critical mass is reached, and then a plateau as saturation is approached. Adopters are categorized into innovators, early adopters, early majority, late majority, and laggards, each with distinct characteristics.

The social system influences diffusion through its norms, networks, and opinion leaders. Diffusion is faster in social systems with strong networks, supportive norms, and opinion leaders who champion the innovation.

In the context of primary prevention in rural Cameroon, Diffusion of Innovations Theory is relevant for understanding how new prevention practices (e.g., vaccination, handwashing, use of insecticide-treated nets) are adopted by communities. The theory suggests that interventions should address the perceived characteristics of the innovation, leverage trusted communication channels, work with opinion leaders, and account for the time required for adoption (Rogers, 2003; Greenhalgh et al., 2004).

2.3 The RE-AIM Framework

The RE-AIM Framework, developed by Glasgow, Vogt, and Boles (1999), provides a comprehensive framework for evaluating the public health impact of interventions. The framework identifies five dimensions that should be assessed to determine whether an intervention is likely to be effective in real-world settings.

Reach refers to the proportion of the target population that participates in the intervention. Interventions with high reach are more likely to have population-level impact, even if individual

effects are modest. Reach is influenced by accessibility, affordability, and acceptability of the intervention.

Effectiveness refers to the impact of the intervention on key outcomes under real-world conditions. Effectiveness differs from efficacy, which is measured under ideal, controlled conditions. Interventions that are efficacious in research settings may be less effective in real-world settings due to lower reach, lower fidelity, or contextual factors.

Adoption refers to the proportion of settings and organizations that adopt the intervention. Interventions with high adoption are more likely to have widespread impact. Adoption is influenced by the perceived fit of the intervention with organizational priorities, the availability of resources, and the support of leadership.

Implementation refers to the extent to which the intervention is delivered as intended (fidelity) and the resources required for delivery (cost). Interventions with high fidelity are more likely to achieve their intended effects. Implementation is influenced by the complexity of the intervention, the training and support provided to implementers, and the organizational context.

Maintenance refers to the extent to which the intervention is sustained over time, at both the individual level (long-term behavior change) and the organizational level (institutionalization). Interventions that are not maintained do not produce long-term population health benefits.

The RE-AIM framework is particularly valuable for evaluating primary prevention interventions in rural Cameroon because it focuses on both internal and external validity, and it emphasizes the importance of reach to vulnerable populations—a key concern given the social determinants of health discussed in Article 2 (Glasgow et al., 1999; Glasgow & Emmons, 2007).

3. EMPIRICAL LITERATURE REVIEW

3.1 Individual-Level Approaches

Individual-level approaches to optimizing primary prevention effectiveness include tailored education, behavior change communication, and motivational interviewing. Tailored education involves adapting health messages to the specific characteristics of the individual, including their

literacy level, language, cultural background, and health beliefs. Behavior change communication uses theory-based strategies to influence knowledge, attitudes, and intentions. Motivational interviewing is a counseling approach that helps individuals resolve ambivalence about behavior change.

In rural African contexts, individual-level approaches have shown mixed effectiveness. They are most effective when they are culturally adapted, delivered by trusted community members, and combined with interventions that address structural barriers (Peretti-Watel et al., 2009; Haddad et al., 2004).

3.2 Interpersonal-Level Approaches

Interpersonal-level approaches include peer education, family engagement, and social support interventions. Peer education involves training community members to deliver health messages to their peers. Family engagement involves working with families to support health behaviors of individual members. Social support interventions involve creating networks that provide emotional and practical support for behavior change.

In rural African contexts, interpersonal-level approaches have been effective for promoting prevention behaviors, particularly when peers are selected from trusted community networks and when they receive adequate training and supervision (Kagambega, 2014; Radi, 2023).

3.3 Community-Level Approaches

Community-level approaches include community mobilization, participatory planning, and engagement of traditional leaders. Community mobilization involves bringing community members together to identify health problems and develop solutions. Participatory planning involves community members in the design and implementation of interventions. Engagement of traditional leaders involves working with chiefs, elders, and other respected community figures to support prevention efforts.

In rural African contexts, community-level approaches have been highly effective for promoting prevention behaviors, particularly when they respect local norms, build on existing community

structures, and empower community members to take ownership of interventions (Nhanag, 2021; Ezaane & Gonta, 2023).

3.4 Organizational-Level Approaches

Organizational-level approaches include health system strengthening, integration of prevention into routine services, and training of health workers. Health system strengthening involves improving the availability, accessibility, and quality of health services. Integration of prevention into routine services involves adding prevention activities to existing clinical services. Training of health workers involves building the knowledge and skills of health workers to deliver prevention interventions.

In rural African contexts, organizational-level approaches are essential for ensuring that prevention interventions reach the population and are delivered with quality. However, they require sustained investment and political commitment (Haddad et al., 2004; Kagambega, 2014).

3.5 Policy-Level Approaches

Policy-level approaches include intersectoral action, resource allocation, and regulatory measures. Intersectoral action involves collaboration across sectors (health, education, agriculture, transportation) to address the social determinants of health. Resource allocation involves directing funding and other resources to prevention activities, particularly in underserved areas. Regulatory measures involve laws and regulations that promote health, such as tobacco taxes or food safety standards.

In rural African contexts, policy-level approaches are essential for addressing the structural determinants of health, but they are often difficult to implement due to political constraints and competing priorities (CSDH, 2008; Solar & Irwin, 2010).

4. SYNTHESIS: KEY APPROACHES FOR MBALMAYO

Based on the theoretical and empirical review, several key approaches emerge as particularly relevant for optimizing primary prevention effectiveness in Mbalmayo.

Multi-level interventions that address determinants at multiple levels of the socio-ecological model are more effective than single-level interventions. Programs should combine individual education, family engagement, community mobilization, health system strengthening, and policy advocacy.

Participatory approaches that involve community members in the design, implementation, and evaluation of interventions are more effective than top-down approaches. Participatory approaches ensure that interventions are culturally appropriate, build community ownership, and empower communities to sustain interventions over time.

Contextually adapted approaches that are tailored to the specific characteristics of the Mbalmayo context are more effective than standardized approaches imported from elsewhere. Adaptation should be based on formative research to understand local knowledge, attitudes, practices, and barriers.

Integrated approaches that combine multiple prevention interventions (vaccination, hygiene, nutrition, etc.) are more efficient and potentially more effective than single-intervention programs, as they address multiple risks and can be delivered through the same platforms.

5. APPLICATION OF THE RE-AIM FRAMEWORK FOR EVALUATION

The RE-AIM framework provides a valuable tool for evaluating whether the approaches implemented in Mbalmayo are achieving their intended effects.

Reach should be assessed by measuring the proportion of the target population that participates in each intervention, disaggregated by social determinants (income, education, distance, etc.) to identify whether vulnerable populations are being reached.

Effectiveness should be assessed by measuring changes in key outcomes (vaccination coverage, hygiene practices, disease incidence) and by comparing outcomes between participants and non-participants.

Adoption should be assessed by measuring the proportion of health facilities, community organizations, and other settings that adopt the interventions.

Implementation should be assessed by measuring fidelity (whether the intervention was delivered as intended) and cost (the resources required for delivery).

Maintenance should be assessed by measuring whether behavior changes are sustained over time and whether interventions are institutionalized within health systems and communities.

6. CONCLUSION

This article has determined the approaches that have been implemented to optimize the effectiveness of primary prevention interventions in rural areas of Cameroon. Drawing on the Socio-Ecological Model, Diffusion of Innovations Theory, and the RE-AIM Framework, the analysis reveals that effective approaches operate at multiple levels: individual (tailored education, behavior change communication), interpersonal (peer education, family engagement), community (community mobilization, participatory planning, engagement of traditional leaders), organizational (health system strengthening, integration into routine services), and policy (intersectoral action, resource allocation).

The RE-AIM framework is identified as the tool par excellence for evaluating whether interventions reach vulnerable populations, achieve their intended effects, are adopted by implementing organizations, are implemented with fidelity, and are maintained over time. Future research should apply the RE-AIM framework to evaluate existing prevention programs in Mbalmayo and should use the findings to guide the design of improved interventions.

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