

Research Article

EXPANDING INDOOR RESIDUAL SPRAYING FRONTIERS OF KNOWLEDGE FOR IMPACT AND MALARIA ELIMINATION: A TALE OF INNOVATIONS AND INSIGHTS, ZAMBIA

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ABSTRACT

Vector control practitioners' failure to innovate stays in the inability or reluctance to adopt major frontiers of knowledge, as this may be attributed to the legacy content of "we know it all," believing there has been continued success within the "thinking box" and not "thinking outside the box". As a result, vector control practitioners fail to seek new innovations and opportunities, hampering continued success. This paper shows that the role of innovation for vector control improvements has been by commitment (Buy-in and collaboration), empathy (Passion and assessment), defining problems and ideation (Team work & planning), prototype (Implementation & availability of resources; human, material and financial), Pilot testing (Evaluation of the innovation), good financial allocation (Resource mobilization & allocation), outcomes (Behaviour change, status of disease rates, community empowerment & impact). In this respect, three known paradoxes of innovations have been identified; first, that some innovations diffuse rapidly, yet are of unproven value or limited value or pose risks, while other innovations could deliver benefits to the public but remain slow to achieve uptake. Second, community participation including collaboration with stakeholders and partners may be the best way of achieving sustainable positive innovation. Third, innovations clearly depend upon change that generates new challenges. In this regard, vector control improvements of systems may struggle to keep up with the pace of innovation, narrowly focused on new system-wide practices and technologies. In summary, a new recognition of challenges of innovation have been proposed and arguably that there is a need to address new approaches along with "thinking outside the box".

Keywords: Indoor Residual Spraying, Knowledge, A tale, Innovation, Zambia.

INTRODUCTION

Public health leadership of the 21st century, unquestionably requires innovative ideas and new skills to face the myriad of wicked public health malaria problems and challenges that are at critical juncture for potential intervention improvements. The public health interventions for malaria need to adapt to the complex context of the century. During the 20th century, public health enjoyed a number of successes. However, declining public health resources and complex health threats have made it difficult for advances of the past century to be sustained^{8,9,5,29,28}. In addition, public health agencies have also arguably been ill equipped to sustain these successes and to address the complex malaria morbidity and mortality threats, that we face today, that are associated with emerging and re-emerging of infectious diseases in the error of flat funding. The Zambian National Malaria Elimination Program (NMEP) and its partners through its transformational vector control leaders and staff, have not been afraid of taking risks to develop innovative approaches to combat malaria through primary vector control interventions⁸. Similarly, the World Health Organization Innovative Group (WHIG) has been striving to promote World Health Organization's (WHO) image and position on health innovation to the outside world³³. In this respect, WHO defined health innovation as an approach to develop and deliver new or improved health policies, systems, products, technological services and delivery methods that improve people's health. Further, innovation has been described as the using of new ideas that lead to the making of new technology and using new ways of thinking to add value to an existing idea or product and to make substantial changes

in society³³. To put it differently, public health innovation refers to the development and or implementation of a novel process, policy, products or paradigm shift leading to improvements that impact health and equity. Health innovations respond to unmet needs by employing new ways of thinking and working with a special focus on the needs of vulnerable populations. Further, innovation adds value in the form of improved efficiency, effectiveness, quality, safety and or affordability. Innovations could be preventive, promotive, therapeutic, rehabilitative and or assistive care. The Innovation's approach has been by holistic approach that builds on the notion of "Integrated Innovation", which is the coordinated application of scientific/technological social and business innovation to develop solutions to complex challenges.

Problems/challenges hindering vector control innovations

Vector control innovations have been fast becoming one of the most important factors for NMEP's success and growth. As such cultivating innovation must be critical NMEP Initiative. Despite that, many NMEPs face major internal challenges of the progress of vector control innovations. As a consequence, there have been various observed challenges/problems to vector control innovations⁴:

Vector control practitioners are not empowered to innovate

Many managers at levels have fear of thinking outside the box and feel innovation will violate policies or will distract junior staff from their day-to-day roles. As a result, many staff do not feel empowered to take risks or try new vector control ideas. Internal innovation requires the support of NMEP leadership and management to take hold across the vector control program. In this regard, sustaining innovation and

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creativity has been a process with many components that interact in a dynamic vector control and energizing way^{15,32}

Vector control practitioners are not motivated to innovate

Once the vector control professionals are empowered, they must feel the motivation to innovate motivation initiatives like inventor innovative programs, contests or unstructured time could help encourage employees to spend time innovating^{15,32}.

Missing innovative strategies for vector control

The innovative strategies are very credibly important elements in taking vector control from the usual challenging malaria issues to emerging new comer challenges in implementing activities. Vector control innovating constantly must ensure its ear is always to the ground to stay proactive instead of being reactive, but in many cases, that's easier said than done. An effective innovation strategy such as (i) Building an expansive vector control innovation network. For vector control to be successful innovation strategy must come from building an empowered innovation network that could work to foster innovation by building a culture deeply rooted in vector control passion^{9,23}. Additionally, vector control teams that nature innovation culture, team members are enabled to innovate to solve problems. (ii) Developing strong processes and systems. Importantly, however, there is need to focus on developing strong vector control processes and systems that address the creation, development, execution and the measurement of ideas. Vector control teams could among themselves submit ideas, and weigh how they could fit into the broader innovation strategy for vector control. Addressing the operational development of these processes build the backbone on which vector control innovation strategy could grow²³.

Constant evaluation of success (or failure)

The vector control teams must build and scale up any strategy through constant review and measuring of the progress. As vector control implements the systems and processes, must also include regular mechanisms for collecting and evaluating data. Bench marking the successes of innovations could mean measuring the usage of innovation. Regular bench marking and measurement allows vector control practitioners to view what pieces of the innovation strategy is working well or not so well, so that leadership could replicate success¹⁷.

Innovation is centralized to one functional group

This becomes a hindrance to innovate as innovation is given more to grow such as research for example and acute health services. The myth that one functional group is more suited to innovate than others within the NMEP has been a severe hindrance to the pace of innovation; each unit at NMEP provides a unique perspective on the problem of malaria to the public which could be critical for driving successful innovation²³.

Inadequate collaboration with partners.

Vector control collaboration has been key to innovation, when partners and stakeholders understand the importance of collaboration internally, collaboration externally could be equally important. Innovation ecosystem that has been a network of stakeholders collaborating together in order to increase an opportunity and innovation to benefit the whole, instead of its parts¹⁹. Startup

incubators must share ideas and learn best practices from vector control experts in order to magnify the chance of their success. Successful vector control program has learned to reap the benefits of innovation ecosystems to improve their own individual success and the success of their campaigns. Collaborative innovation allows every stake holder to glean pieces of shared knowledge, work and to some degree share costs²⁵. This allows vector control more effectively solve public problems of higher complexity, leading to offerings which have greater value to the public and thus, generating more demand.

Lack of diversity in vector control

One of the most critical parts of vector control becoming a successfully innovative program is luring the right staff to innovate. The NMEP must attract the right vector control staff and must evaluate prospective staff for innovation, while it's alleys not crystal clear³². If someone is an innovator upon first introduction, there are certain qualities one could look for that may be indicative, such as: willingness to try new things, excitement for solving problems, tolerance for ambiguity, passion for learning, betterment and highly skilled. There is need to create an environment in which innovation could innovate freely. Nurturing an innovation culture has been credibly important because it allows employees to innovate safely and effectively, bringing greater value to vector control program¹⁸

Current/traditional vector control services considered successful

Vector control programs risk complacency once their current activities have reached success. The fear of pulling public attention from existing activities to new ones could be one of the biggest hindrances to future innovation. However, constant innovation is the key to sustained success for a long term¹⁷.

Missed connections with the public

Deep public empathy is the key to understanding changes in demand and staying abreast of the future trends. It provides vector control with a road map for what problems to solve next. Utilizing public feedback sessions regularly could help keep vector control tuned into the needs of the public^{3,22,31}.

Measuring Innovation incorrectly

Measuring and bench marking is core to constantly improving its success. However, Key Performance Indicators(KPIs) like coverages may not give vector control the best insight into success. When beginning innovation initiatives, it's important to be aware of and plan for these challenges. Building strong innovation culture for vector control, not only helps to avoid these challenges but also to ensure that innovation has strategic focus for every vector control team member²². In this article, we set out to share the vector control initiatives from 2017 to 2021 by outlining individual initiatives. Whilst the prime aim is to influence the vector control practitioners to start innovations wherever they may be in order to spice the program by thinking outside the box.

Objectives

To share innovative interventions implemented in Zambia and also to influence vector control practitioners to innovate

Specific Objectives

1. To show why vector control practitioners rarely come up with innovations
2. To outline the Zambian innovations for primary vector control interventions
3. To clarify the need to improve vector control practitioner's capacity building to deal with the challenges, both positive and negative of innovation
4. To inform vector control practitioners to always study innovation and link new interventions to outcomes (both intended and unintended).
5. To promote increases in the health status of the community served by vector control interventions through experimentation, risk taking and creativity.

Methods and materials

We reviewed literature on promoting new era of innovation in public health practice and the performance of vector control interventions since the initiation of the innovations (2018 to 2021). More guidance came from: an introduction to the concept of a community population health practice system approach to promoting success in resource stratified communities. We further exploited external ideas presented by the community in held meetings, focus group discussions, conferences and feedback from the general public and communities served through the traditional leaders, partners and stakeholders. The other ideas were gathered and evaluated during Technical Working Groups, Technical Advisory Committees (TACs) and field experiences. Both formal and informal talks with stakeholders at all levels with vector control teams were able to deduce the innovation risks, costs, and dedication, as the many ideas also came straight from external vector control practitioners' contributions.

Major Findings

From the literature review, key findings emerged: nine themes of innovation kept recurring between definitions. We describe the findings of innovation which show that there are nine themes of innovation; having an idea (60%), executing an idea (60%), and the key one being addressing a real change (40%), adding value to the program (40%), adding value to the community (40%), differentiated perspectives/thinking (27%), moving forward (13%), definition not being important (13%), addressing new service areas (7%)^{6,19}. By analyzing these components from various definitions of the world's experts, the ultimate definition of innovation becomes as "executing an idea that addresses a specific challenge and achieves value for both vector control and the community"⁶. This suggests that coming up with something new and original is vital to differentiate the vector control intervention services being offered. Just as important as coming up with an idea is actually making it become creativity. It is the use of brainstorming ideas if none of them ever seem to be more than a sticky one. Innovations need to provide a solution to an actual service need problems (even if beneficiaries do not realize they have them yet). Too many innovations come up with solutions to problems that do not exist, and then vector control practitioners struggle to understand why nobody is buying them^{29,17}. Our findings on public health innovation strategy, at least hint that NMEP need to benefit from the innovation for it to be viable and considered a success. Usually this means that the innovation must make a reduction to malaria morbidity and mortality and help the NMEP score its goal. The community could also perceive the innovation to have enough value to be worthwhile. This is an important finding in the

understanding from several experts, highlighting the fact that innovative thinking requires a different approach to what has worked historically. It does always need to be radical; it must help evolve the way vector control thinks and approach challenges. The present study confirmed the findings about vector control programs that try to keep doing the same things, forever, that are likely to eventually be out maneuvered by other health competing health programs that are willing to try something new or different. Innovations must help the programs to adapt to changing to the changing environment^{11,29}. Another promising finding was that several experts believe that a unified definition is not important, as it may vary between organizations or programs. Innovations must help the NMEP succeed and access either new community segments or new underserved communities in the districts for extended impact. In this respect, there are five known success factors of highly innovative institutions or programs: (i) innovative process (ii) innovation culture (iii) Innovation management (iv) Idea generation (v) Innovation capacity. Two questions remain to be answered: where do new ideas come from in an institution and how are these ideas generated in the institution or program? Innovation could be generated from the (i) organizational structure (ii) leadership style (iii) motivated employees (iii) Availability of tools and methods. In addition, the above success factors to the generation of innovations, have been categorized as; **success factor1:** A different understanding of innovation, **success factor:2** Risk-taking as an NMEP value, **success factor:3** Customer orientation, **success factor:4** Innovation leadership, **success factor 5:** Innovation dominating the entire NMEP^{20,11,14,10}.

How to measure Innovation Results and Outcome?^{30,26,14,28}

We acknowledge however, that there are considerable discussions among researchers as to public health innovation been a process that is best managed with long term perspective, not necessarily measured in long time increments (e.g., months, years) but rather in completion of targeted goals. Further, this requires separating the innovation process into three important stages 1) identification of goals and exploration of activities, 2) short term deliverables 3) near term development. Identification of goals and exploration activities, defined the course of action and establishes the motivational inspiration for the entire innovation of the ideation process. Setting forth a vision for the innovation goal and providing opportunities to explore various, solutions enable innovator buy-in to the goal. The goal has been identified, the steps that need to be accomplished for the success of the program could be prioritized, assigned to stage 2 or stage 3 and executed accordingly. It is important to realize that stage 2 and stage 3 are not static and should be routinely reviewed and updated. As goals in stage 2 are completed, some of those in stage 3 move into stage 2 to provide the basis for a new set of measurable results and outcomes. It is management's responsibility to assess performance to goals in each stage and determine when a goal has been complemented or moved into a different stage. By splitting the execution phase into 2 stages the innovations process yields a continuous flow of near-term successes which maintains innovation motivation.

DISCUSSION

The biggest challenge faced by vector control practitioners is the fact that despite decades of countless best practice initiatives and decades of extensive implementation of vector control primary interventions and strengthened financial investments campaigns, the practitioners have not successfully achieved improved health of the

populations as required. In terms of reversing this trend, we must continue to re-examine our continued practice of adopting new innovation approaches that end up being a new way of doing the same old things. It has been very important for the health policy makers and vector control practitioners to understand the drivers of innovation practices. The innovation objectives have been goals to improve vector control by an order of magnitude. It has to be known that innovation typically requires experimentation, risk taking and creativity. Further, there are many common types of the objectives of innovation such as time by making things faster, or potentially slower, if that has value and increased of productivity, getting more vector control output for an hour worked, efficiency, getting more output for a unit of input. There is need also for convenience by making things easier for customers and also observing issues of quality of IRS performance; transforming quality and solving an unsolved problem such as households' refusals towards spraying households. This also goes for house hold owners experience to the campaign and sustainability by transforming a process that is not likely to end well to one that has a bright future. As a result, health innovation has been identified as new or improved health policies, systems, products and technological services and delivery methods that improve people's health and well-being. It has been found that health innovation responds to unmet public health needs by creating new ways of thinking and working with a focus on the needs of vulnerable populations. Innovations aim to add value in the form of improved efficiency, effectiveness, quality, sustainability, safety and or affordability. In addition, the health innovation could be preventive, promotive, curative and rehabilitative and or assistive care. In this respect, the Zambian vector control team has strived to come up with a chain of initiatives ranging from 2018 to 2021: originator-assisted, targeted, internal venturing, continuous improvements and strategic transfer¹⁵. The vector control team converted problems to ideas and the innovation system are both formal and informal taking place outside the established channels. The team's passion for vector control is the fuel, and pain is the hidden ingredient. The passion is what has been propelling ideas for coming up with innovations. Unfortunately, when pursuing a passion or following a dream, pain becomes part of the process. The team always pursues passion or following a dream, while pain has been part of the process and learnt to manage both effectively. Further, the team had co-lated drives for effective exchange of the ideas by providing physical proximity among communities and stakeholders including various partners, build the trust that has been essential to the innovation process. This has increased the possibility of greater exchange of vector control information stimulation of creative thinking in one another and critique of ideas during their formative stage. The vector control team has leveraged differences that normally divide people such as language, culture and problem-solving styles that have become a boom to innovation. When differences are used constructively could be leveraged to enhance and sustain the innovation process. If any vector control practitioner could use these principles can stay focused ahead. Let the vector control practitioners have customized leadership development learning journey, designed to build the skills and capacity of leaders needed in times of flat financing of the interventions. The practitioners must go through leading through change, have emotional intelligence, risk -taking and practice resilience⁵. Many innovative vector control tools have been implemented by the Zambian NMEP and appreciated by the users and beneficiaries:

Community-Based Indoor Residual Spraying Delivery Model

Traditional IRS in Zambia is slowly being replaced by a vector control candidate tool; the Community-Based Delivery IRS Delivery Model.

This is a new model to organize IRS operations with mini operational sites established or the whole district operation. Community Health Workers (CHWs) or Community Health Assistants (CHAs) serve as IRS team leaders and assume responsibility for managing store rooms; as washers, operators and data collection and reporting. Spray operators are hired from the same communities and do not require transport and campaign facilities. Instead, they go home at end of each spray day. The plan came about to shift from traditional IRS to the new model by incorporating the planning and execution of the operation at community level through the primary health care structure. The main reasons for this paradigm shift were to (i) increase community participation and acceptance (ii) reduce cost and make it more sustainable; and (iii) increase structure coverage¹⁵.

Deployment of Indoor Residual Spraying Commanders for enhanced IRS Supervision

Learning from the army security aspect of commandeering, Environmental Health Officers[EHOs] and Environmental Health Technologists [EHTs] capacity in supervision was enhanced. The Commanders take possession or control of Indoor Residual Spraying for impact and excellent coverage of targeted structures and data management, while always in touch with the province, district leadership, Indoor Residual Spraying Managers and Teams including Spray Operators(SOPs).Commanders track and assess indoor residual spraying implementation on daily basis. These officers must have individual commandeering work plan, learn every day and strategize for the following day and have always in-depth analysis. A Commander must analyze coverage trends on daily basis. He or she must identify emerging Indoor Residual Spraying issues, problems and be on top of things and critically assess the campaign and realign it for Indoor Residual Spraying for impact¹⁵.

Implementation of Responsive Indoor Residual Spraying in areas of malaria rebound

Based on evidence of disease burden, generated on malaria incidence and fatality in a particular community of the health facility targeted catchment area, given a threshold of malaria cases. This is assumed that ITNs and Community Health Workers (CHWs)/Neighborhood Committees are maintaining caseloads low with implementation of case management and reactive case detection. This approach principle is when cases look like are rebounding. The approach could be implemented by the use of the Community-Based IRS Delivery Model approach using SOPs from the community where Indoor Residual Spraying is being implemented. The community is highly involved where spraying operations are conducted as much as possible. There is need to encourage local community ownership. The chemical with a short residual insecticide efficacy is the first insecticide of choice though other insecticides could be used. Community mobilization still remains cardinal for the exercise¹⁵.

Deployment of GRID 3 mapping micro-panning tool

Grid3 technology locates settlements so that all people whether they live in farmland, suburbs or cities are visible to policy makers, critical service providers (vector control practitioners) and other stakeholders. Zambia uses GRID 3 mapping in house hold enumeration of structures for IRS and LLINs. Settlements with above 25 residential structures are labeled with GRID ID prefixes followed by a number and building count/populations of 102. Settlements with below 25 residential structures are labeled with only the number of

residential structures. Settlements below 25 residential structures and without labels have only 1 residential structure. Available landmarks are used on the map to get familiarized with the map and always one has to try to start identifying settlement from land marks one is familiar with moving along roads and other features¹⁵.

MSpray/Reveal Technology

Indoor Residual Spraying program in the past did not have access to maps as showing households that need to be sprayed. Mspray has been a revolutionary tool that incorporates three processes to achieve maximum impact for indoor residual spraying dollars. Recent current reporting systems have not been obtaining precise location of Indoor Residual Spraying events in relation to malaria cases, which poses challenges for effective and efficient malaria elimination. In addition, this information is also critical to avoid unnecessary human exposure to Indoor Residual Spraying insecticides. Spray/reveal is mobile based application (Mspray) to collect comprehensive information on Mspray events¹⁵. The Mspray strengths have been (i) Readily available technology (ii) Good coverage in most places (iii) Ease to use (iv) Gets GPS coordinates to generate maps (v) Has time date stamp (vi) Allows for tracking routes of workers and can overlay malaria cases (vii) Can use phone camera to document data stored locally on phone and free of google secure server (ix) Gives real time spray information (x) Mspray is the first cell-phone application developed to document Indoor Residual Spraying operations (xi) The information collected could improve efficiency of malaria control operations (xii) Really-time homestead-level data allows for more targeted malaria interventions and Mspray allows for real time spatial overlay of malaria cases and spray events. (xiii) Mspray could result in reduced human exposure to potentially harmful pesticides.

Community Engagement through Royal Highnesses and other Traditional Leaders

Traditional leaders have been heavily engaged in vector control activities/campaigns as they play a prominent role at community level in Zambia. Community engagement through the Royal Highnesses has been a process of working collaboratively with and through groups of people affiliated by geographic proximity with special interest, or similar situations to address issues affecting the well-being of those people. Engagement with the community requires that not only the process but also every action involved being done with integrity¹⁵.

Introduction of data visualization techniques and tools

Data visualization has been an approach to interdisciplinary field that deals with the graphic representation of data. It is a particularly efficient way of communicating when the data is numerous as for example a time series. We used Data Disease Management Systems (DDMs), communicate care, spatial mapping and DHIS2. The data visualization techniques: charts, plotting, maps have been deployed etc¹⁵.

Strengthened partnership in malaria vector control

Partnership reduces the burden of vector-borne diseases through effective, locally appropriate and sustainable vector control. Engaging in partnerships to combat malaria became a key aspect of 360 degrees vector control approach. The approach extends from multi-stakeholder initiative with government and NGOs to NMEP collaborative Initiatives. Partnership allowed sharing knowledge and

know-how that gave an inspiration and provided us with an opportunity to share new ideas on prevention, control and elimination across geographically relevant areas¹⁵.

Monitoring and Evaluation Toolkit

The tool kit is useful for identifying major short comings in IRS operations. Therefore, the IRS Monitoring and Evaluation tool kit [M&E] was developed to strengthen national level monitoring evaluation and supervision of the IRS practices for great effectiveness. It is a tailored M&E guide for IRS campaign operational context's distinctiveness. The tool gives robust guidance to supervision and other interested parties¹⁵. The tool was developed to support IRS programs for impact through systematic M&E processes and outcomes to allow timely detection of gaps and constraints and so ensuring that adequate responses are triggered for correctional measures. The toolkit was meant not only to assist vector control managers in their daily practice but also as a background document for training and capacity building at all levels of the vector control implementation program. It was designed to be a working document to be adjusted during every spraying campaign on it received from those who have applied it in the district environments. Further, it was developed to help managers build an M&E program in a systematic way so that errors and deviations from planned activities could be identified and corrected at an early stage. In summary, the kit was developed in six parts: Introduction, Good and Poor IRS Practices and the need to decentralize CB-IRS Delivery model, Section A, B, C, D, E, F and Appendices¹⁵.

Development of A "How- to" Manual for the Community-Based IRS Delivery Model

As a result of community health experiences, it was found necessary to develop a facilitator's or Trainer's guide and expand its focus through the Community Health Strategy (2017-2021) in order to implement the model concept. The guide is meant to build the capacity of Primary Health Care "Gate Keepers" and the Community Health Workers and it fully supports the model implementers¹⁵.

Formulation of the Community Executive Committees for the Implementation of the Model

The formation of the committees is to oversee the implementation of the model and this committee must be chosen by the whole community and not just a fraction or few fractions of the community. This is where unity organization remains important. The Executive Committee must be part of the community and be responsible to the community IRS needs. The formulation of the committee must be transparent and democratic process for good Community Neighborhood Committee representation and other community members in an integrated way. The community must undertake the implementation of the activity from an informed base. The committee must make its resources assessment [base] and other Community Based Volunteers (CBVs) including Community Based Organizations (CBOs). The assessment must be onsite and analyzed and the findings must be presented to the community as a whole at public meetings¹⁵.

District Indoor Residual Spraying Operational Committee

The District Health Management Teams (DHMT) must have an operational plan made up of various disciplines of the DHMT to decide on the activities to be implemented for IRS. Admittedly,

responsible DHMTs must provide oversight and pro-equity commitment to the District, Rural Health Centers (RHCs) and the community they serve. The community leadership has been essential to building and maintaining the model based on primary health care concept and principles. However, health authorities must further engage with and respond to RHCs Advisory Committees. Good planning by the implementing urgency helps communities to shape and exercise control over their social, physical, economic and cultural environment. The implementation must begin with community mobilization¹⁵.

Introduction of Indoor Residual Spraying Quality Assurance

In the wake of increasing malaria cases in Zambia, IRS has been coming under increasing accountable pressure from the public for the need for quality of IRS performance and its decentralized approach. In response, a new IRS approach; Community-Based IRS Delivery model has been introduced in the country and institutionalized in the community health care system using the Donabedian approach methods for the implementation of the model. Quality assurance becomes strong and successful when its well organized with features of health atmosphere that IRS teams, SOPs, the household owners and becomes a common goal as a result of good level management¹⁵. The District IRS Operational Committee typically must possess quality assurance learning environment, improvements and leadership support initiatives. These could be supplemented by enabling tools and nurturing quality friendly atmosphere within the IRS teams and SOPs as front liners. The Donabedian Model for improvement of quality has been widely adopted in the hospital/care set up but has not yet been fully recognized, utilized and validated in the vector control system. Donabedian model's structure-process - outcome is a valid model for implementing quality approach in the IRS campaign. The intervention that performs well in terms of structure tend to perform better for quality service delivery processes that in turn have favorable influence on the community health status outcomes¹⁵.

Increased Spray Bases to Promotion of Equity of Access

Increasing spray bases enhanced awareness by the users to health care intervention barriers which may be experienced by people with intellectual disabilities and also the need for reasonable adjustment and consistent use of such strategies in practice. The equal access for IRS need, followed the principles of equal access to health care. This alludes equal utilization of the health care for those in equal need of it. Equal (or rather, equitable) health outcomes (as measured by quality adjusted life expectancy). The IRS bases dotted in the community make IRS feasible and accessible to the population. Demand for IRS has been usually influenced by factors such as knowledge, information, cultural beliefs and indirect financial costs such as travel and the opportunity costs^{15,26}.

Strengthened Social Mobilization and Increased number of social mobilisers

During IRS campaign, capacity building was enhanced to the community in participatory aspects of IRS. This upgraded the level of awareness among poor and socially excluded community, through social mobilization and community and development of the intellectual capacity of the participation to support and strengthen her gender balance and intensiveness in the community. This approach brought together all societal and personal influences to raise awareness and cultivated sustainable individual and community involvement. Social

mobilization was found making it more responsive and accountable to people's needs and demands. To achieve social mobilization (SOCMOB) requires a new way of working, harnessing the considerable synergies across goals. It is the back bone for strengthening local partners and ensuring that it remains accountable to people's overlapping needs^{15,20,17,18}.

Indoor Residual Spraying (IRS) and Long-Lasting Treated Bed nets (LLINs) COVID-19 Guidelines

Work safety Guidelines in the wake of COVID-19 outbreak were developed for the two primary interventions. The NMEP vector control team remained alert to the disease transmission and informed about changing out-break conditions, including community spread of the virus and testing availability and implementation of infection prevention and control measures. Good practices were enhanced such as continued implementation of the critical areas of the guidelines and strengthening social distancing and temperature checks at reporting in the morning and during knocking off time and use of masks¹⁵. The vector control team assigned a work place coordinator responsible for COVID-19 issues as an open eye identification of where and how workers might be exposed to COVID-19 at work. This included a thorough hazard critical assessment to identify potential work place hazards related to COVID-19. Further, identification of a combination of measures that hinder the spread of COVID -19 in the work place, in line with the principles of the hierarchy of controls, this included a combination of eliminating the hazard; engineering controls, work place administrative policies, Personal Protective Equipment (PPEs) and other measures prioritizing controls mostly at least effective to protect workers from COVID-19 hazards¹⁵. More specific guidance was given to: (i) Eliminating the hazard by separating and sending home infected or potentially infected people from the work place (ii) Installing barriers where physical distancing cannot be maintained (iii) Suppressing the spread of hazards using face coverings (iv) Improving ventilation (v) applicable PPEs to protect workers from exposure (vi) Providing the supplies necessary for good hygienic practices (vii) performing routine cleaning and disinfection (viii) Continuous educating and training spray teams on COVID-19 policies and procedures using accessible format and a language they understand¹⁵.

Introduction of Community Action Cycle (CAC) for Social mobilization & Community Empowerment

Community Action Cycle empowers and helps families to their health basic needs, help individuals attain their health educational goals and ultimately help people strengthen their own families. CAC has proven community mobilization approach that fosters individual and collective action to address key malaria intervention, goals and related outcomes. It links three activities; planning, implementation and Evaluation^{15,16}.

Facilitation of the Deployment of Provincial and District Malaria Elimination Officers (MEOs)

Deployment of MEOs in 116 districts of the country ensured that coordination of optimal relation to the functions for malaria structure at levels. The staffing of these officers has been a broader concept than the deployment itself. In addition, this implied a strategic approach being along process that anticipated future needs and the situation of malaria elimination. The whole idea was to create a clear and comprehensive release and deployment of officers that could spear head the goal to malaria elimination officers¹⁵.

Strengthening Capacity Building [Virtual Meetings, Open Forum Discussions, Literature and Research Publications Sharing

Specifically, knowledge has been very cardinal for vector control practitioners in general. Many new things keep coming and there is a need to keep investing in improving and increasing sustained availability of vector control technical staff, accessibility, adaptability of the population to interventions and maintenance of quality of vector control work force. In addition, there must be a very good vector control organizational frame work: A mission/vision must exist for NMEP including attention on vector control interventions and need to follow policies and procedures^{24,21,23}.

Leadership of vision and coordination must also exist.

As can be expected, there must be an existing culture of communication, team work, and engagement of stakeholders, partners and the community on matters of vector control. Vector control has to follow systems approach in terms of planning, supervision, monitoring and evaluation, financing (Resource Mobilization) and procurement and supply chain management including value chain management. The vector control practitioners must always practice transparency in staff recruitment/staffing, give required roles and responsibilities with equitable evaluation and feedback to levels including building up staff capacity, implementers and beneficiary capacities^{31,23,13,12}.

Promoting Excellent Vector Control Leadership

For the most part, leadership started with establishing confidence with vector control leadership and other staff. The technical staff demonstrated their qualities by example, motivated each other to do the work, and can be listened to by anyone in the team. Their door must be always be open. They should be considered as part of the vector control team and therefore assume its success and failures^{27,13,7,11}.

Support supervision for vector control campaigns

To begin with, this was intensified through use of forms, monitoring toolkit for IRS, frequent visits to service delivery areas. This process helps staff to improve their own work performance. It was carried out in a respectful and non-authoritarian way with a focus on using supervisory visits as an opportunity to improve knowledge and skills of front liners and the process encouraged open, two-way communication and built team approaches that facilitate problem solving. Further, it focused on monitoring performance towards agreed goals and through using data for evidence-based decision making that depended upon regular follow-ups with staff to ensure that new tasks are being implemented correctly^{15,14,17}. Support supervision helped to make things work, rather than checking to see what was wrong. The supportive approach, where supervisors and spray teams work together to solve problems and improve performance, deliveries improved results for vector control interventions. The supporting approach look at; focus on improving performance and building relationships, more like a teacher, coach, mentorship by use of local data to monitor performance and solve problems through, regular follow ups and only support provided. However, training a core set of supervisors, creating checklists and recording forms and also ensuring appropriate resources were given and available-vehicles, subsistence allowance through collaboration with other programs^{15,31,1}.

Peer Supervision during Indoor Residual Spraying Campaign

This supervision approach was used during the IRS campaign by spray teams to decrease professional isolation increases professional support and networking, normalizes the stress and strain of professional's life and multiple perspectives on any concern or problem. Peer supervision has been found to have added benefits of being free of charge, intellectually stimulating and firm. There is a saying "peer supervision-no-one knows as much as all of us". Peer supervision differs from more traditional forms of supervision in that it does not require the presence of a more qualified identified expert in the process a supervisor. It is a reciprocal arrangement in which peers work together for mutual benefits where IRS process feedback emphasized and self-directed to learning and evaluation has been encouraged^{2,1}. There are a number of things that can and do go wrong if individuals are left to lead their own supervision processes and maintaining the quality and effectiveness over time is a challenge. In addition, peer supervision includes increased access frequency of supervision, reciprocal learning through the sharing of experience, increased skills and responsibility for self-assessment and decreased dependency on expert supervisors². Peer supervision can play a valuable role in giving more people more access to more supervision which in turn impacts on the quality of service to housed hold owners.

Directly Observed Supervision(DOSF) Form

The supervisors used DOS form to ensure the spray operators are in compliance with correct wearing of the spray pump using the shoulder strap(s) and ensure that there has been adequate lighting before starting to apply insecticides. A free hand must always be used to hold the flashlight the work area in cases of dark rooms. The tip of the nozzle of a spray must be 45cm away from the wall (middle position). There must be a 5cm overlap with each swathe. The SOP must always move towards the right of the surface to be sprayed and the spray pump must always be shaken vigorously after every 5 swathes¹⁵.

Other major important innovations introduced were:

Increase of sentinel sites from 22 to 39 and revamping of twelve (12) old ones, introduction of subcommittees for LLINs distribution [Monitoring & Evaluation, Planning & Coordination Committees], DDT Risk Management Plan, Social Behavior Change & Communication and introduction of an annual Vector Control Seasonal Planning Calendar¹⁵

Operational Research innovations to enhance vector control functions for impact

This has been an analytical method of problem solving and decision making that is useful in the management of vector control campaigns. Problems were broken-down, into basic components and then solved in defined steps by the processes used such as; (i) Identifying a vector control problem that needs to be solved (ii) constructing a model around the problem that resembles the real world and variables (iii) testing each solution on the model and analyzing its successes (iv) implementing the solution to the actual problem²⁷. In summary, the processes of operational research have been to achieve the best performance under the given circumstances. The vector control team continued to innovate through the results of the operational research. The study topics/documents or checklists were

published here in, mostly qualitative research in order to give direction to the needs of improving vector control activities, more especially Indoor Residual Spraying:

- Indoor Residual Spraying Community-Based Delivery Model and Community Empowerment for Malaria Elimination. Lessons Learnt, Best Practices and Approach Methods in Zambia (2019).
- Effectiveness of the Royal Highnesses in Community Engagement and Indoor Residual Spraying Implementation (2020).
- Implementing Quality; a missing piece with a need for process of behavior change. A case for implementing quality CB-IRS D-Model in Zambia (2020).
- Transforming Supervision Practice: Deployment of Indoor Residual Spraying Commanders for enhanced supervision essentials, Zambia(2020).
- Expanding the Indoor Residual Spraying Frontiers of knowledge for impact and Malaria Elimination: A tale for Innovations and insights, Zambia(2021).
- Improving Indoor Residual Spraying for malaria Elimination: Emulating Success Factors, Lessons Learnt and Best Practices from Cholera Out-Break in Zambia(2018).
- A toolkit for effective monitoring and evaluation of Indoor Residual Spraying Implementation Campaign Responses to Malaria Elimination in Zambia(2018).
- A "How-to" Manual for Action Cycle to Community Mobilization and Empowerment Focused on Community-Based IRS Delivery Model(2018).
- Community Based Indoor Residual Spraying Delivery Model(PPT-2021).
- Getting ready for integrated vector management for improved disease prevention in Zimbabwe: a focus on key policy issues to consider(2018).
- Targeting management of mosquito breeding sites in urban and arid communities for Malaria Elimination: Promoting Larval Source Management as avital supplementary Intervention, Zambia(2021).
- Infection Prevention and control during Indoor Residual Campaign. "How to break the chain of transmission"(2020).
- DDT Risk Management Plan (2019) & COVID -19 IRS Risk Management Plan (2019)
- Infection Prevention and Control During LLINs Mass Distribution and Implementation [Including Pre & Post Tests) (2020).
- Closing the Gap: Evaluating management and planning for Insecticide resistance Framework, Zambia (Still under authorship).

CONCLUSION

Vector control innovations are available to enhance the new best practices and are not intended to replace public health policy guidelines but to tailor interventions to meet local needs. The traditional public health model approaches are useful but vector control practitioners are more likely to promote innovation by allowing opportunities for building commitment, empathy, passion, ideation and prototyping. Malaria could be better addressed through vector control innovation-driven creativity and greater collaboration. The aim of vector control continuous learning of effective innovations can only come when there is a reasonable willingness to accept failures as essential for making innovative improvements. However, there are

"good failures" but their notion could be difficult for vector control practitioners, stakeholders and partners to accept, because failure has been often viewed as antithesis of success. The key to good failure is that it can accelerate the learning process. Further, the vector control practitioners must always study innovations, at the same time as they are occurring, and data must be collected to link the new innovation to the outcome, both intended and unintended.

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Author's Contribution

EHK collated the material for this publication and drafted the manuscript, read it and approved the final manuscript.

Competing Interest

The Author declare to have no competing interest.

REFERENCES

1. Benschoff J.M (1982). Clinical supervision research from 1981 to 1993.A methodological critique
2. Benschoff JM (1989). Peer supervision in the therapeutic Field.
3. Bergeron K et al., (2017). BMC Public Health Innovations
4. Bryar M R(2006).New challenges and Innovations in community health Nursing
5. Center for Disease Control and Prevention. Ten Great Public Health achievements in the 20th century (2017). <http://CDC.gov/about/history/tengpha.htm>
6. Creswell J.W(2008).Chapter 3 the use of theory 4th ed. Thousand Oaks.
7. Department of Health for England (2004):Choosing health: Making Healthy choice easier.
8. Eng R.Thomas (2004).Population health technology: Emerging Innovations for health of the public.
9. Fun M, Simpson S, PackerC (2010). Identification of Innovation in Public Health.
10. Furr N et al., (2004). The innovator's method: Bringing the lean start-up into your organization
11. Healey BJ, Lesneski CD (2011). Transforming public health practice: Leadership and Management Essentials. <https://books.google.com/books>

12. Human Resources for Health Development (2030) www.hrh2030program.org.
13. Investing and Innovating for Women's, Children's and adolescents' health at UNGA72.
14. Jacobs J. A et al., (2012). Tools for implementation an evidence-based approach in public health practice.
15. Kooma E.H(2021).Expanding Indoor Residual Spraying Frontiers of knowledge for impact and malaria elimination: A tale of innovations and insights, Zambia.
16. Lebonthe R, LaverackG (2001). Capacity building in health promotion, part1: for whom? And for what purpose? Critical public health.
17. Lepine A,Largarde M, Le Nestoir A (2014). Free primary health care in Zambia: an impact evaluation using a pooled synthetic control method.
18. Lavery M,Gentry D,Klesges LM (2015).Innovations in public health education: Promoting professional development and a culture of health.
19. Lister C et al., (2017). Health innovation model: Merging private sector processes with public health strengths. www.frontiersm.org
20. Lister C. et al., (2015). The Laugh model: Reframing and Rebranding public health through social media.
21. Miley MP (2005). What is capacity building? Lessons from a national demonstration program of HW education for social service providers.
22. NissenP (2015). Making sense of implementation theories, models and frame works. Implement SCI.
23. Norman CD, Chairman-Burger J, YIP AL Saad S, LomberdoC (2010). Designing health Innovation networks using complex sciences and systems thinking: the CoNEKTR
24. Olley ML(2007).Implementing continuig education strategy to advance practice and practitioner development within an infection control service.
25. Partnerships to Scale Health: EWES Innovation market place Breakfast event at WHA71.
26. Perrin B. (2002). How to-and How not to evaluate Innovation?
27. Primary HealthCare Research and Development (2006).
28. Public health financing. CDC Website (2017) www.cdc.gov/stit/public_health_health_financing
29. Rogers EM. Diffusion of Innovations,4th ed.
30. Rychetnik L, FonnerM, Han PBetal., (2002). Criteria for evaluating evidence on public interventions
31. The Cochrane collaboration (2004). Cochrane Health Promotion and Public health Field Epidemiology. Epidemiology Community Health.
32. US Department of Health and Human Services (2019).
33. WHO Health Innovation Group (2015)
34. World Health Organization Innovative Organization (2014-2019). <https://www.who.int/topics/innovations/en/v>.
35. Kennedy M, (2018). Employees Driven Innovation. www.learnventures.se
