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Health Interventions to Promote the Polio Vaccine within the Global Polio Eradication Initiative: A Systematic Review From 2000-2014.

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Abstract

HEALTH INTERVENTIONS TO PROMOTE THE POLIO VACCINE WITHIN THE GLOBAL POLIO ERADICATION INITIATIVE:

A SYSTEMATIC REVIEW FROM 2000-2014.

By

Aime Serge Dali

November 28th, 2016

INTRODUCTION: Launched in 1988 by the World Health Organization (WHO), the primary goal of the Global Polio Eradication Initiative (GPEI) was to eradicate polio by the year 2000. The mobilization of communities was critical in achieving this goal. Although the disease has persisted beyond the year 2000, the number of cases dropped compared to their level in 1988, witnessing significant progress.

AIM: As polio is near being eradicated, this study is an attempt to review health communication and behavior change interventions used to promote the polio vaccine within the GPEI in order to highlight best practices and lessons learned to be used eventually to combat other vaccine-preventable diseases.

METHODS: A systematic analysis of peer-reviewed articles describing interventions to promote polio vaccine, increase community awareness and parents' adherence to immunization activities from 2000 to 2014 within the GPEI across the world was conducted.

RESULTS: Of the 15 publications included in the review, five reported on health promotion interventions analysis and planning frameworks, eight reported on public health communication interventions, and one article reported on ecological approaches. Interventions grounded on analysis and planning frameworks resulted in increased awareness, real-time rumors tracking, and addressing controversy and mistrust about the vaccine. Interventions based on public health communication theories resulted in increased support from policy makers, community, and religious leaders as well as increased community involvement in activities. These interventions also increased knowledge and attitude changes toward immunization. Lastly, ecological approaches demonstrated their usefulness in conducting multi-level analysis to identify social etiologies of a persistent low polio vaccine rate.

RECOMMENDATIONS: Since polio campaigns are required as long as there will be a single case, evidence-based and theory-driven behavior change and communication interventions may still be of help. They can help ensure people's adherence to subsequent rounds and avoid campaigns fatigue, both at the global and country levels. Furthermore, to take extensive advantage of all health promotion strategies used in the GPEI, further research, that includes peer-reviewed and other types of documentation, is needed to better inform future programs to increase the overall immunization coverage.

KEY WORDS: Polio eradication Initiative, Behavior Changes Theories, Communication for public health theories.

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Author's Statement Page

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Aime Serge Dali

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Acronyms

AFP:	Acute Flaccid Paralysis
DCPEV:	French acronym of the Management Team of the Expanded program of Immunization within the Ministry of Health
FGD:	Focus Group Discussions
GPEI:	Global Polio Eradication Initiative
HPV:	Human Papillomavirus
HW:	Health Workers
IDI:	In-Depth Interviews
IPV:	Inactivate Polio Vaccine
M&E:	Monitoring and Evaluation
N/A:	Non-Applicable
NID:	National Immunization Days
OPV:	Oral Polio Vaccine
PAPM:	Precaution Adoption Process Model
PRECEDE-PROCEED:	Predisposing, Reinforcing, and Enabling Constructs in Education/ecological Diagnosis and Evaluation-Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development
RAP:	Rapid Assessment/Appraisal procedures
STDs:	Sexually Transmitted Diseases
TMC:	Transtheoretical Model of Change
Unicef:	United Nations Children's Fund
WHA:	World Health Assembly
WHO:	World Health Organization
WPV:	Wild Polio Virus

Introduction

Poliomyelitis, also known as polio, is an infectious disease caused by the wild poliovirus (WPV). There are three serotypes (1, 2, & 3), all responsible for the disease. Polio spreads from one person to another through stools and contaminated hands. The main symptom is the paralysis that extends progressively to the whole body and can lead to death. That's where the name "crippling disease" comes from. There exists an effective vaccine to prevent this infectious disease, and this vaccine has two presentations: the oral polio vaccine (OPV), which contains the alive attenuated virus, and the inactivated polio vaccine (IPV), which contains the inactivated virus (Minor, 2016).

Known as one of the most disabling vaccine-preventable diseases, polio has retained the attention of the world's leading public health agencies and was the target of an exceptional mobilization from public health experts and communities. As Patel & Orenstein (2016) pointed out, thanks to the combined efforts from the stakeholders, the number of polio cases across the world has dropped considerably. In 1988, there were 350,000 cases in more than 125 endemic countries in the world. By the end of 2012, the number of cases dropped by approximately 99%. Of the six epidemiological blocks, as defined by the World Health Organization (WHO), three—Americas, Western Pacific, and Europe—were certified polio-free respectively in 1994, 2000, and 2002 (GPEI, 2016). The wild poliovirus type 2 has been eradicated since 1999. As of October 2016, 27 cases of polio caused by the wild polioviruses and 3 cases of vaccine-derived poliomyelitis were discovered across three endemic countries: Afghanistan, Pakistan, and Nigeria (WHO, 2016; WHO, 2016b). The factors identified as being the causes of the persistence of the wild polioviruses in these countries were social (community resistance and vaccine refusal), political (armed conflicts and collapsed health systems), and logistics (hard-to-reach children and lack of adequate infrastructures to store the vaccine) (GPEI, 2016; WHO, 2016).

The Global Polio Eradication Initiative, also known as GPEI, is among the efforts which contributed to this significant drop in the number of polio cases in the world. Launched

in 1988 by the WHO, this initiative is implemented in collaboration with the U.S. Centers for Disease Control and Prevention, Rotary International, Unicef, and the Governments members of the World Health Assembly (WHA). The primary goal was to eradicate polio by the year 2000 (GPEI, 2016). Through this initiative, a number of activities were conducted, namely National Immunization Days (NID) against polio, acute flaccid paralysis (AFP) surveillance, and routine immunization strengthening. The mobilization of communities was also part of the activities conducted within this initiative. Although the disease has persisted beyond the year 2000, the number of cases dropped, compared to its level before 1988, witnessed that significant progress was achieved.

Building on this progress, the efforts intensified during the time period 2000-2012, and the number of polio cases dropped to its lowest level ever in 2012 with 222 cases (Patel, & Orenstein, 2016). In order to consolidate this achievement and reach the points beyond, the GPEI's stakeholders wrote in 2012, the Polio Eradication and Endgame Strategic Plan 2013-18 (GPEI, 2016). This plan has four main objectives: (1) early detection and interruption of any circulating poliovirus; (2) oral polio vaccine withdrawal and switch with the inactivate polio vaccine within robust routine immunization programs; (3) certification of polio eradication and containment of all remaining and existing wild polioviruses; (4) polio legacy and transition plan to use lessons learned and resources from the GPEI to combat others vaccine-preventable diseases (Cochi, Hegg, Kaur, Pandak, & Jafari, 2016).

Consistent with objective number 4, we proposed to review health promotion interventions conducted during the time period 2000-2014 to ensure people's adherence to polio campaigns. More specifically, we reviewed documented, publicly available theory-driven behavior change and health communication interventions that were implemented during that period of time.

Rationale

Theory-driven behavior change and health communication interventions contributed to ensuring mothers and caregivers' adherence to polio campaigns, and they were critical in raising awareness among communities and decision-makers regarding the disease. On the other hand, these activities also contributed to the advocacy to get various donors embarked into the polio eradication initiative (Cochi, Freeman, Guirguis, Jafari, & Aylward, 2014).

Since there has been a huge investment in polio vaccination campaigns, and the global health community is closer than ever to eradicating polio, the time has come to consider whether to build on the lessons learned and transfer all the resources, including best practices, from the GPEI to other programs dedicated to combat other vaccine-preventable diseases. For example, the WHO estimate reveals that 535,000 children under eleven months are still dying annually from measles, whereas there is an effective vaccine to prevent this infectious disease (WHO, 2013). Then, best practices and lessons learned from the GPEI, with regards innovative behavior change and health communication interventions to increase vaccine acceptance, could be useful in the fight against measles. More broadly, these learned lessons can help in increasing, in a sustainable way, routine immunization coverage, and ultimately lead to the decrease of the burden of vaccine-preventable diseases among children, and inform other public health efforts. Indeed, the vaccine-preventable diseases are, by far, the largest causes of death among children under 11 months in many developing countries (WHO, 2013). In addition, health care providers and community workers, based on their experience during their field work with the GPEI, are well-skilled to deal with the increasing phenomenon of parents who are vaccine-hesitant. This concept refers to parents who refuse or delay vaccination for their children despite the availability of immunization services in their surroundings (MacDonald, 2015).

Study Objectives

This study aims to carry out a review of health communication and behavior change interventions used to promote the polio vaccine within the GPEI. The objective is to contribute to the polio legacy by highlighting best practices and lessons learned, in terms of health promotion activities implemented during the time period 2000-2014, to be used eventually to combat other vaccine-preventable diseases. The research questions are as follows:

- What are the behavior change and health communication interventions designed to ensure mothers', caregivers' and communities' polio vaccine acceptance within the GPEI?
- What are the underlying theories, models, and constructs of these interventions?
- What were the outcomes of these interventions?
- What is the gap, and how can the lessons learned help to improve overall immunization coverage?

Literature Review

Behavior Change and Communication in Public Health

As suggested by Frieden (2014), public health refers to "a set of actions aiming to maintain, protect and improve health of the communities either through diseases and injuries prevention or through healthy behavior and life style promotion, using health education" (p.17). These healthy behaviors are under the influence of various factors, also called determinants. Determinants relate to social, environmental, and biological factors, as well as the individual's personality. As suggested by DiClemente, et al. (2013), identifying these determinants helps understand the nature and the underlying motivations of someone's behavior. Behaviors are various in types, based on their occurrence during the lifetime. Some are contextual (e.g., use of condom), some are performed on a regular basis (e.g., diet or physical exercise), while others are executed only once during the lifetime (e.g., immunization). In each of these cases, it is about changing from an old behavior to a new one that is likely to prevent the individual from getting sick. In other words, it is about

modifying the way someone behaves. This behavior change process consists of going through different stages until the individual reaches the goal of giving up the risky behavior and adopting the expected healthy behavior.

To implement behavior change and communication interventions, public health professionals may use theories and models drawn from social sciences. According to Schiavo (2014), "theories and models help clarify how to approach health issues, and in developing and organizing ideas to design interventions that aim to change individual's behavior" (p.34). More broadly, theories and models provide a basis for intervention planning, monitoring, and evaluation. They also inspire methodological approaches to health issue identification, and ultimately contribute to the intervention implementation (Schiavo, 2014). In other words, behavior change and communication theories and models help analyze and explain how changes occur at the individual, community, and societal level. Theories and models are also used to analyze factors that influence behavior change and the conditions under which this influence occurs. Moreover, McKenzie, et al. (2013) define a theory as "a systematic arrangement of fundamental principles that provide a basis for explaining certain happenings of the life" (p.163). As for the models, the same authors state that they draw on a number of theories to help understand a specific problem in a particular context or setting. However, in the field of health education and promotion, both concepts, theories and models are used interchangeably and provide a framework to generate verifiable assumptions, integrate empirical evidence, and prepare a roadmap to develop strategies and implement intervention. These theories and models have key concepts, known as constructs.

Use of Behavior Change and Communication Theories in Health Promotion: Overview

For the theories and models to be used, planners have available a number of intervention analyses and planning frameworks. The PRECEDE-PROCEED Model is one of the planning frameworks widely used. The underlying approach of this model is to start by identifying the problem or the desired result, determine the causes of this problem, and ultimately, design an intervention that aims to address the identified problem (McKenzie, et

al. 2013). In other words, this model works backwards, identifying the problem first in order to ascertain the causes. Once the causes are identified, the intervention can be designed, grounded on the behavior change and communication theories and models (DiClemente, Salazar, & Crosby, 2013).

Borrowed from the social sciences, a number of theories and models are used for the purpose of health education and health promotion. There exist different types of classification. DiClemente, et al. (2013) categorizes theories as either value-expectancy theories; the models based on perceived threat and fear appeals; the stages models for health promotion; the ecological approaches; the social cognitive theory applied to health behavior; the diffusion of innovations theory; and the communication theories for public health.

The first category, which comprises the value-expectancy theories, suggests that an individual is likely to engage in a behavior change process if he/she expects to draw a benefit greater than the "cost" or consequences that relate to not engaging in the new behavior. This cost can be social, emotional, physical, or financial. The Theory of Reasoned Action, the Theory of Planned Behavior, and the Information-Motivation-Behavioral Skills Model fall in this category (DiClemente, Salazar, & Crosby, 2013). According to the Theory of Reasoned Action and the Theory of Planned Behavior, the overall attitude toward the health behavior and the subjective norms are two independents constructs that precede the intent. Although these theories have in common the two constructs, they are different in that the Theory of Planned Behavior adds another construct: the perceived behavior control. This construct refers to the perception related to external factors, as well as objective realities that may facilitate or inhibit the adoption of the health behavior (Ajzen, 2002 as cited by DiClemente, Salazar, & Crosby, 2013). The Information-Motivation-Behavioral Skills Model, on the other hand, assumes that having a high degree of knowledge (information) pertaining to the behavior is considered pre-requisite to behavior change. This model speculates that increased relevant information leads to improved behavioral skills, which, in turn, may

promote increased odds to actually performing the behavior (DiClemente, Salazar, & Crosby, 2013).

The second category is composed of the models based on perceived threat and fear appeals. It includes the following:

- The Health Belief Model, which suggests that two constructs, the perceived threat and the expected net gain, can influence an individual in adopting a health-protective behavior. This model assumes that inconsistencies between beliefs and behavior create cognitive dissonance that can be uncomfortable or even threatening and therefore motivate people to seek or restore a balance between beliefs and behavior (Ross, et al. 2010).
- The Protection Motivation Theory, which suggests that when faced with fear-arousing stimuli, individuals can either adopt positive, adaptive responses to avoid the threat or, instead, choose maladaptive, negative behaviors that ignore the risk. This theory assumes that individuals go through a process that includes assessment of the risk to hurt them, severity of the potential damage, effectiveness of the response, and the individual's perception on his ability to perform the expected behavior (Gaston, & Prapavessis, 2014).
- The Extended Parallel Process Model posits that individuals will either accept a fear appeal message and engage in a danger control process or reject a message and engage in a fear control process (Birmingham, et al. 2015).

The Protection Motivation Theory and the Extended Parallel Process Model are, in many ways, communication theories in that they attempt to explain how and why individuals respond to and act (or do not act) in response to fear-arousing messages. Indeed, this can be contrasted with behavior change theories that focus more on helping understand which factors predict engagement in particular behaviors (DiClemente, Salazar, & Crosby, 2013).

The third group is the category of the stage models for health promotion. The Transtheoretical Model of Change (TMC) falls in this group. This model describes the stages people go through to adopt a new behavior and the mechanisms that lead to this behavior

change. The model has four core constructs: the stages of change, processes of change, decisional balance, and self-efficacy (Choi, Chung, & Park, 2013). Another model that falls in this same group of the stage models is the Precaution Adoption Process Model (PAPM). This model, like the TMC, asserts that people pass through a sequence of stages before ultimately achieving sustainable behavior change. However, close examination shows that the key difference is the emphasis placed on environmental factors. In the PAPM, the environment is the main influencer of behavior change throughout the stages (Delara, et al. 2013).

The fourth group includes the ecological approaches, consisting of approaches targeting the multiple levels of behavior influences. These approaches encompass a number of theories and models including, but not limited to (a) the Bronfenbrenner's Model of Human Development, suggesting that the fit between the person and the environment influences successful development, (b) the Social Action Theory, which states that behavior change occurs as a consequence of psychological regulation and goal-directed action, and (c) the Structural Model of Health Behavior, which emphasizes four categories of environmental factors viewed as critical in shaping health behavior: availability, physical structures, policy and social structures, and media and cultures (DiClemente, Salazar, & Crosby, 2013). These approaches suggest that behavior is influenced by a number of external factors at various levels of the individual's social environment. Consequently, interventions designed under the ecological approaches are meant to address factors at these various levels to have the expected impact (Fisher, et al. 2005).

The fifth category is the Social Cognitive Theory applied to health behavior. This theory suggests, like in the ecological approaches, that social environment has a central impact on behavior and that personality and an individual's characteristics alone cannot explain behavior (Hatchett, Hallam, & Ford, 2013). The theory's key constructs are (1) knowledge, which is a necessary but non-sufficient condition for behavior change. Another related construct to knowledge is behavioral capability, which consists of one's knowledge and skill to perform a behavior; (2) perceived self-efficacy, which is the perception that an

individual has on his/her ability to perform a specific action; (3) outcome expectations, which are an anticipation on the positive results expected from the adoption of the new behavior; (4) goal formation, which consists of defining goals to reach gradually on the way toward the new behavior; (5) and socio-structural factors inclusion.

The sixth group consists of the Diffusion of Innovations Theory. This theory is grounded on the principle that large-scale health behavior change is possible by developing an approach that is viewed as novel and by targeting established social systems. According to Roger (as cited by DiClemente, Salazar, & Crosby, 2013), this theory is a process by which an innovation is communicated through specific channels, over a period of time, and within a group pertaining to the same social system. Diffusion of Innovations Theory has four key constructs, which are innovation, communication channels, time, and the social system (Dingfelder, & Mandell, 2010).

The last and seventh category in the classification is the group of the communication for public health theories. Communication for public health refers to the use of communication strategies and tools to inform, to influence and to improve public health (Schiavo, 2014). Communication for public health conceives attitudes as the mediator between the message and the effective behavior change. Attitude, on the other hand, is influenced by persuasion, which is a key element for the change in the attitude. With this in mind, health communication specialists work on messages meant to change attitude, rather than merely inform people.

The Reception-Yielding Model and the Elaboration Likelihood Model fall within this category. The Reception-Yielding Model posits that persuasion is a result of a process starting from getting the audience attention and moving toward comprehension and acceptance (DiClemente, Salazar, & Crosby, 2013). The Elaboration Likelihood Model is used when the intent of the health communication specialist is to change a specific attitude, and in turn the behavior that corresponds to the attitude under consideration (DiClemente, Salazar, & Crosby, 2013). The models described above are used in the field of communication for public health along with the two following planning frameworks: social

marketing and tailored communication. While tailored communication refers to the principle of designing personalized and individualized messages, social marketing targets a broader audience and borrows its principles from commercial marketing (Schiavo, 2014). It underscores the importance of four elements, referred to as the four Ps of social marketing: (1) Product, (2) Price, (3) Place, and (4) Promotion. Product is the behavior that the program seeks to see adopted by the intended audiences. In social marketing, product can be tangible (e.g. condoms or mosquito nets being sold or distributed as part of a social marketing campaign) or intangible (e.g. a behavior recommended and adopted by the intended audiences). Price refers typically to the price of the product being promoted or the emotional, physical, communal, or social cost of adopting the new behavior or practice. Place is defined as the location where the intended audience is most likely to be reached with communication messages and tools to facilitate the adoption of the new behavior. Finally, promotion refers to how messages are conveyed. In other words, it refers to how to motivate intended audiences so they try and perform the recommended behavior or adopt a new practice (Luca & Suggs, 2013).

Behavior Change and Communication Theories in Immunization Programs

A number of authors have reported that some of the theories and models previously described were already used to design and implement immunization programs. A study by Askelson et al. (2010) evaluated mothers' intentions to immunize their daughters aged 9-15 years old against Human Papillomavirus (HPV), by using the Theory of Planned Behavior. The research team found out that, mothers' attitudes and subjective norms were the main predictive factors of their intentions to vaccinate their children. However, it was noted that the perception of the risk by the mothers, their own experience with sexually transmitted diseases (STDs) and their beliefs regarding the vaccine, did not have any impact on their intentions to vaccinate their children. These results were used to develop an HPV vaccination campaign.

Another article reports the work by Bodenheimer, Fulton, & Kramer (1986) to identify factors influencing health professionals' decisions to get the hepatitis B vaccine, using the

Health Belief Model. The results revealed that the beliefs related to the vaccine's safety and effectiveness were factors influencing the most health professionals' decision to get the vaccine. Building on these findings, the authors recommended that any intervention aiming to promote the hepatitis B vaccine should reinforce these beliefs.

In the same way, Roncancio, et al. (2016) report a formative study that applies social marketing to assess the needs and preferences of Hispanic mothers of adolescents in order to guide the development of interventions to increase Human Papillomavirus (HPV) vaccine series completion. Results suggested that the factors influencing vaccination (the *product*) were a desire to complete the vaccine series, to prevent illnesses, to protect their children, and the vaccine reminders. The majority of mothers who completed the vaccine series did not experience barriers that prevented this vaccine series completion. Besides, mothers who initiated the vaccines series and did not complete it perceived a lack of health insurance and the cost of the vaccine as potential barriers. In addition, the study revealed that informational barriers were prevalent across both market segments (*price*), and that clinics were important locations for deciding to complete the vaccine series (*place*). The clinics were also the preferred sources for obtaining information about the HPV vaccine, making them ideal locations to deliver intervention messages (*promotion*).

These examples highlight how behavior change and communication theories may contribute to designing interventions that aim to promote healthy behavior, including in the field of immunization. The global polio eradication initiative should be an ideal framework to analyze the extent to which behavior change and communication theories have been successfully used to increase mothers' and communities' adherence to immunization activities.

Methods

Literature Search

A systematic review was conducted to address the study's research questions. According to Cronin, Ryan, & Coughlan (2008), a systematic review consists of identifying and providing the most complete list of all documentation that relates to a topic of interest, in a specific field, and for a well-defined period of time. These authors explain that the systematic review uses explicit and rigorous criteria to identify, critically evaluate, and synthesize the literature available on a topic of interest. This work targeted peer-reviewed articles that described the interventions to promote polio vaccine or to increase community awareness and parents' adherence to immunization activities across the world within the GPEI over the time period 2000-2014. The documentation is thus limited to articles that have been published in a peer-reviewed journal and that relates to immunization promotion activities conducted within the GPEI. The documentation search was conducted through Georgia State University and Emory University libraries and through the GPEI web site.

Nine databases, divided into two categories, were explored. These databases were chosen based on their ability to provide relevant information on the topic. The databases consulted are as follows:

- Databases for research in humanities and social sciences:
  - Sociological Collections.
  - PsycInfo.
  - Psychology and behavior sciences collection.
  - Communication & Mass Media Complete.
  - Psychology Database.
- Databases for research in health:
  - PubMed.
  - CINAHL.
  - Global Health.
  - Public Health Database.

For the literature search, the following search terms were used: “Behavior Change Theories”, “Communication for public health theories”, “Polio eradication Initiative”, and “Immunization program”. These search terms were combined and applied to every single database.

Inclusion and Exclusion Criteria

Filters were applied to the results of the literature search based upon the study objectives. These filters were assigned as follows:

- The article should report on an intervention implemented during the time period 2000-2014.

- The article should report on an intervention implemented in the framework of the global polio eradication initiative.

- The article should report on an intervention implemented to promote the polio vaccine and polio campaigns.

The choice of the time period ranging from 2000 to 2014 is justified by the fact that the global polio eradication initiative implementation could be divided into 3 periods:

- The first period started in 1988, the date of the launch of the GPEI, and lasted until the end of the year 2000, which was the first deadline of the GPEI. It was marked by the setup of the initiative and the actual start of the field activities. Although progress, such as the eradication of the wild polio virus type 2, was made, no other significant result was obtained, and the objective of a world-free from polio was not achieved by 2000. According to Taylor & Shimp (2010), at that time, data suggested that mass awareness and general public support were not the eradication’s priority issues. As a result, the use of data in polio health communication was of variable consistency and quality. There was an absence of evaluation research throughout the global polio initiative communication work, whereas the challenges were related to technical and logistic issues.

- The second period ranged from the year 2000 to the year 2014; it showed an intensification of the efforts, a readjustment of some activities and an increase in financing, while taking in account lessons learned from the first decade 1988-2000. It was marked by major

successes, such as the polio eradication in three of six WHO epidemiological regions, and the attainment, for the first time, of the lowest number of polio cases since the launch of the GPEI in 1988 (WHO, 2013). This time period was also characterized by the universal call for a better use of social sciences and communication data across the polio program (Taylor & Shimp, 2010).

- The third period is the period from 2014 to date. It is marked by the consolidation of the assets, the preparation for the certification of the eradication, and the polio legacy and transition preparation plan to face new public health challenges.

While there were notable weaknesses in the evaluation of communication activities' contributions to polio eradication prior to the early 2000s, the period 2000-2014 seems to be the time period during which well-designed health promotion activities, likely to have impacted the polio eradication initiative, have been implemented. This is the reason why the systematic review has focused on the documentation reporting activities conducted during this period. Documentation reporting on the GPEI activities before the year 2000 and after the year 2014 was excluded from this systematic review. In the same way, documentation describing behavior change and communication interventions targeting immunization programs outside the framework of the GPEI was not included in this systematic review.

Documentation Analysis

The documents identified for the review were collected, classified, categorized and analyzed using Excel and Zotero Standalone. Zotero Standalone was used to collect and manage references, whereas Excel was used for classification, categorization, and content analysis. Documentation was comprised of peer-reviewed articles, and we ensured the selected documents provided additional context about behavior change and health communication intervention within the GPEI. The classification proposed by DiClemente, Salazar, & Crosby (2013) was used for the purposes of this review. With each article included in the systematic review, whenever this was possible, the content analysis consisted of:

- Identifying the study design and the study settings.
- Identifying the study objectives.
- Identifying the theory (-ies) and their categories, as well as the constructs(s) used.
- Highlighting the key findings.

Results

The literature search conducted through nine databases and using specific search terms listed in the “inclusion/exclusion criteria” section produced 1,079 publications likely to be included in the review. Of these publications, 1,067 were excluded upon thorough abstracts titles and summaries review. Articles reporting on interventions conducted outside the GPEI or papers that were not peer-review articles were excluded based on the description from the summary. Of the 12 remaining publications, an environmental scan—that is a review of the list of references—yielded three other publications.

Ultimately, 15 publications were included in the systematic review (see figure 1 below).

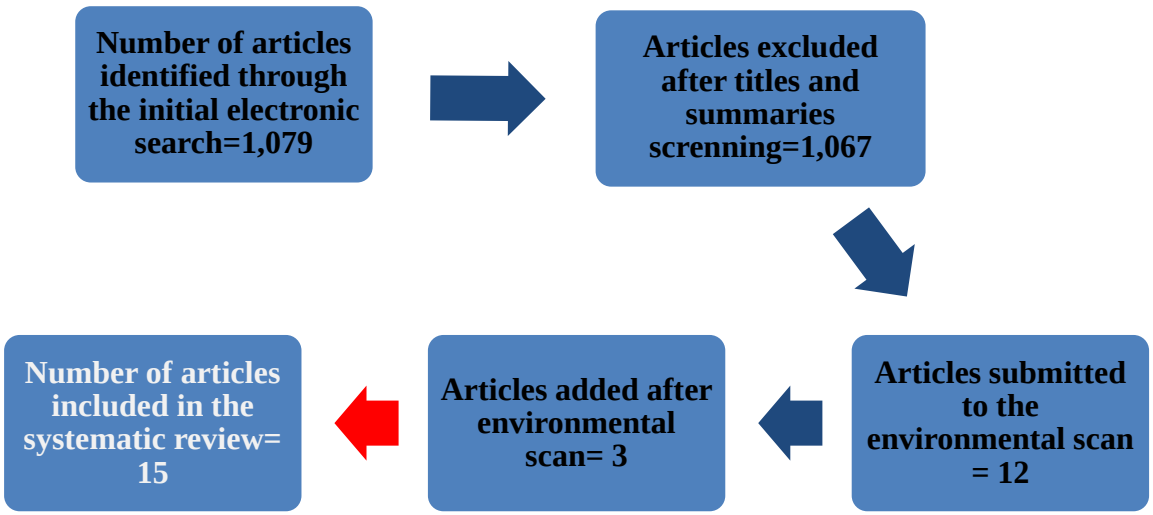

Figure 1: Flowchart of the literature search process.

Next, the selected articles were classified based on the categories drawn from the classification proposed by DiClemente, Salazar, & Crosby (2013), shown as follows:

- Five articles reported on studies that used health promotion interventions analysis and planning frameworks.
- Eight articles reported on studies based on public health communication theories.
- One article reported on the use of ecological approaches to analyze the intervention that was implemented.
- One article was not classified since it was a review of case studies of health promotion interventions conducted in India over a period of 10 years of implementation of the GPEI in this country.

Along with this classification, a content analysis was performed and presented in Table 1. The content analysis is defined as an analysis to determine the meaning, purpose, or effect of any type of communication (literature, newspapers, or broadcasts) by studying and evaluating the details, innuendoes, and implications of the content as well as recurrent themes (http://www.dictionary.com/browse/content-analysis). This content analysis focused on (1) the year the article was published, (2) the category the article falls into, (3) the study objectives, (4) the study design, (5) the study settings, (6) the theoretical considerations and the constructs underlying the intervention described in the article, if any, and (7) the outcomes.

Table 1: Classification of the articles used for the systematic review

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
1. Category of Health promotion intervention analysis and planning frameworks								
1.1.	Factors influencing participation in national immunization days in Kumasi, Ghana (Browne, et al. 2002).	2002	Health promotion intervention analysis and planning framework.	To identify factors influencing participation in polio campaign.	- Cross-sectional study exploratory in approach and descriptive in content (Mix Method). - 800 households sampled in 40 clusters of 20 households.	Ghana (Africa)	PRECEDE-PROCEDE Model to identify Predisposing, enabling, reinforcing factors.	- Factors influencing immunization are identified (education level, access to sources of information, socio-economic status).
1.2.	Parents' awareness and perception of the polio eradication programme in Gombe Local Government Area, Gombe State, Nigeria (Obute, & Arulogun, 2007).	2007	Health promotion intervention analysis and planning framework.	- Determine parents' level of awareness about polio. - Document parents' perception of their children susceptibility to polio. - Determine parents' attitude toward polio eradication.	- Community-based descriptive study using both qualitative and quantitative data. - 422 respondents.	Gombe state, Nigeria (Africa)	Generalized Model.	- High level of awareness about polio. - Low level of knowledge on poliovirus transmission. - Reluctance in the release of children for polio vaccination due to many rounds, fear of vaccine over dose, and belief that vaccine is contaminated.
1.3.	Social determinants and polio "endgame":	2008	Health promotion intervention	To understand perceptions, facilitators, and	Qualitative and Rapid appraisal	Two health districts in India (Asia).	Social Marketing Assessment	- Occurrence of two trends in perceptions (strong trend of

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
	a qualitative study in high risk districts of India (Dasgupta, et al. 2008).		analysis and planning framework.	barriers in implementing polio eradication strategies.	procedures (RAP).		and Response Tools.	synergy and weak trend of divergence of views between HW & community.
1.4.	Communication for polio eradication: improving the quality of communication programming through real-time monitoring and evaluation (Waisbord, Shimp, Ogden, & Morry, 2010).	2010	Health promotion intervention analysis and planning framework.	To examine how GPEI utilized M&E data for communication activities improvement.	Real-time data monitoring using a combination of case-based immunization campaigns, social mapping, and rapid survey techniques.	Afghanistan, Pakistan, India (Asia) and Nigeria (Africa)	- Inclusion of communication indicators in post-campaign monitoring. - Media trends tracking.	-Real-time rumors tracking. -Success in addressing controversy and mistrust about the polio vaccine.
1.5.	Fatigue and Fear with Shifting Polio Eradication Strategies in India: A Study of Social Resistance to Vaccination (Hussain, McGarvey, Shahab, & Fruzzetti, 2012).	2012	Health promotion intervention analysis and planning framework.	To identify social factors associated with resistance to polio eradication program.	-Ethnography /rapid assessment procedures (RAP) including IDI, behavioral observation, and semi-FGD with 27 stakeholders and 80 families who interacted with the polio program.	Uttar Pradesh, India (Asia)	PRECEDE-PROCEDE Model to identify Predisposing, enabling, reinforcing factors.	-Causes of social resistance revealed to be fatigue, confusion, doubt, fear and distrust of the vaccination teams.

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
2. Category of Communication theories for public health								
2.1.	Misunderstanding Communication: Reflections on the Experience of Communication Programs in the Polio Eradication Initiative (Waisbord, 2005).	2005	Communication theory for public health.	-Understand what and how communication contributes to polio eradication -Suggest further contributions for communication.	Review of case-study.	N/A	-Advocacy -Social Mobilization. -Information, Education, Communication.	-Increased support from policy makers. -Increased community participation (vaccinators, transportation support). -Increased in the number of children brought to vaccination booths.
2.2.	Reducing resistance against polio drops (Ansari, Khan, & Khan, 2007).	2007	Communication theory for public health.	To assess the impact of social mobilization and health education program among Muslim community.	Cross sectional study. Total number of family visited : 1,025	High-risk of polio areas, India (Asia)	Door-to-door interpersonal communication & persuasion.	Reduction in the number of family resistant to polio vaccination by 53% and 50% in two areas.
2.3.	Achieving polio eradication: a review of health communication evidence and lessons learned in India and Pakistan (Obregón, et al. 2009b).	2009	Communication theory for public health.		Review of primary and secondary data from communication for public health interventions sources.	India and Pakistan (Asia)	i) Knowledge gaps, and resistance assessment. (ii) Development of interpersonal communication /social mobilization strategies.	-Leaders mobilized -Social networks created. - Increased knowledge. -Attitudes changed. - Increased individual and community level demand. -Gender barriers and resistance are overcome.

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
2.4.	Diplomacy And The Polio Immunization Boycott In Northern Nigeria (Kaufmann, & Feldbaum, 2009).	2009	Communication theory for public health.	To trace communication and diplomatic actions to restart polio vaccination after a boycott.	Case study based on a literature review, examination of previously GPEI documents, and thirteen IDI with people involved in the crisis.	Northern Nigeria (Africa).	Persuasive campaign based on interpersonal communication and media.	The boycott was brought to the end thanks to the efforts deployed by stakeholders.
2.5.	The complexity of social mobilization in health communication: top-down and bottom-up experiences in polio eradication (Obregón, & Waisbord, 2010).	2010	Communication theory for public health.	To assess the impact of social mobilization in relation to internal and external effects to the Polio Eradication Initiative.	Case study drawing on multiple sources (qualitative & quantitative) to provide a perspective of the phenomenon under review.	India and Pakistan (Asia), and Nigeria (Africa).	Social mobilization, mass media campaigns, interpersonal communication (door-to-door), persuasion.	- Community participation has increased - Resisting households are "converted" at a level of 87%.
2.6.	Media and interpersonal persuasions in the polio eradication campaign in northern Nigeria (Ozohu-Suleiman, 2010).	2010	Communication theory for public health.	To provide evidence on how communication influenced community responses to polio campaigns.	- Survey method using questionnaire to collect quantitative primary data. - 2,868 respondents sampled for the study.	Northern Nigeria (Africa).	Persuasive campaign based on interpersonal communication and media.	- Friends and relatives are most influential of interpersonal sources in campaign acceptance and resistance decision of individuals in the communities. - Influence of

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
								interpersonal communication sources is 79.4% greater than mass media in campaigns resistance mobilization.
2.7.	Local Resistance to the Global Eradication of Polio: Newspaper Coverage of the 2003–2004 Vaccination Stoppage in Northern Nigeria (Olufowote, 2011).	2011	Communication theory for public health.	To analyze northern Nigerian newspapers coverage of the 2003–2004 stoppage of the GPEI.	Contents analysis of newspapers on polio vaccination stoppage.	Northern Nigeria (Africa).	Cultural-Centered Approach to heath communication and narrative approach.	- Evidence that confluence of cultural factors undermines the GPEI. -Local knowledge and understandings become obdurate when reinforced by recent scandals. -Understanding of the resistance to the polio vaccine. -Suggestion for methods to increase vaccination rates.
2.8.	Breaking community barriers to polio vaccination in northern Nigeria: the impact of a grass roots mobilization campaign, Majigi (Nasiru, 2012).	2012	Communication theory for public health.	To examine the impact of community-based intervention in the polio vaccination uptake following community mobilization campaign.	Assessment of an educational intervention targeting beliefs and negative attitude towards polio vaccination.	Northern Nigeria (Africa).	Grass roots mobilization & Grass roots campaign.	Community misconceptions and distrust regarding the cause of the disease and the safety of the polio vaccine are addressed.

	Title	Year published	Category	Study objective(s)	Study design	Study settings	Theoretical consideration	Outcomes
3. Category of Ecological approaches								
3.1.	Using data to guide action in polio health communications: experience from the Polio Eradication Initiative-PEI (Taylor, & Shimp, 2010a).	2010	Ecological approaches.	To describe how data analysis shape communication interventions.	Review of primary and secondary social data sources.	India (Asia) and Nigeria (Africa)	Identification of multi-level social etiologies of the persistent low polio vaccine rate.	-Data generated. -Ecological analysis of underlying issues manifesting as noncompliance.
4. Unclassified								
4.1.	Evidence based communication for health promotion: Indian lessons of last decade (Suresh, 2011b).	2011		To advocate for increased linkages between epidemiological and social science research in planning health promotion interventions.	Review of case-study on health promotion interventions.	India (Asia).	N/A.	N/A.

As shown in Table 1, the majority of the interventions described in the articles were implemented in 3 countries, namely India and Pakistan located in Asia, and Nigeria located in West Africa. However, one study was implemented in Ghana (West Africa) and another study in Afghanistan (Asia). The oldest article included in the review was published in 2002 while the most recent article was published in 2011. No article that met the inclusion criteria was found on the global polio eradication initiative website.

As for the theoretical considerations, persuasion (through mass media and interpersonal communication), social mobilization, advocacy, and information-education-communication, were the most widely used approaches across the interventions. Likewise, the PRECEDE-PROCEED model was the most frequently used health promotion analysis and planning framework. One intervention reportedly used the social marketing assessment tool and another used the generalized model.

Regarding the study design, six out of fifteen studies used a mix method (qualitative and quantitative), and three out of fifteen studies used a qualitative method. The remaining study consisted of case studies and reviews.

For most of the studies, the authors claimed that the outcomes were consistent with the studies' objectives, ranging from promoting the polio vaccine to identifying the underlying reasons of the persistence of polio cases in some specific areas. Furthermore, interventions that used a health promotion intervention analysis and planning framework reportedly resulted in increased awareness about polio, real-time rumors tracking, and successfully addressing controversy and mistrust about the polio vaccine. The implementation of interventions grouped under the category of communication theory for public health resulted in increased support from policy makers, and community and religious leaders as well as increased community involvement in overall immunization activities (through vaccinators, and transportation support). In addition, these interventions influenced the creation of social networks and increased knowledge and attitude changes toward immunization. Lastly, individual and community level demand for immunization increased, and gender barriers and resistance were overcome under this intervention. The use of ecological approaches,

however, demonstrated how data generation could help in conducting multi-level analysis to identify social etiologies of the persistent low polio vaccine rate in order to design communication intervention accordingly.

Social resistance and mistrust to polio vaccine were expressed through parents' reluctance in the release of children for polio vaccination. In some areas, communities decided to boycott immunization activities (Kaufmann, & Feldbaum, 2009) and contributed in the spread of rumors (Waisbord, Shimp, Ogden, & Morry, 2010). Causes of social resistance and mistrust were revealed to be fatigue due to many rounds, confusion, doubt, fear and misconceptions about the safety of the polio vaccine such as belief that polio vaccine is contaminated or contained harmful pathogens. This was seen in the study by Obute & Arulogun (2007) where the majority of participants said that "they have heard rumors and misconceptions that polio vaccine contained Human Immuno-Deficiency virus (HIV), contraceptives and other pathogens which were the major reasons for reluctance in releasing children for polio immunization".

As suggested by the articles under review, the ways the resistance and mistrust were addressed were largely dominated by the use of advocacy, interpersonal communication and persuasion, social mobilization, grass roots mobilization, and information, education, and communication.

Discussion

As previously noted, the three study settings that were most frequently mentioned in the articles were India, Pakistan and Nigeria. Taylor & Shimp (2010) explain it by the fact "that these three countries were the last three remaining endemic countries for polio over the past ten years, and were the focus of the global polio eradication initiative stakeholders" (p.49). All together, these countries gathered more than half of the incompletely vaccinated children, of which 32% lived in India, 14% in Nigeria and 7% in Pakistan (Adekeye et al. 2015). The chronically missed children living in these countries were then targeted by a number of rounds of polio campaigns to close the gap in terms of immunization coverage. As a result, data was widely available on polio campaign promotion in these countries. This could be one

of the reasons why the majority of the articles report on interventions that were implemented in Nigeria, India, and Pakistan. The content analysis showed that these activities were primarily health communication interventions. According to Taylor & Shimp (2010), in 2013, the budgets for overall communication activities within the GPEI in the three endemic countries (India, Pakistan and Nigeria) were mostly devoted to communication activities implemented through mass media. That is due to the fact that over the first decade following the launch of the GPEI, the assumption was that demand for polio vaccination existed broadly across populations and that making vaccines available—and informing people of its availability—would be sufficient to get children immunized (Waisbord, 2005). Thus, the initial strategy focused on large-scale, relatively straightforward information dissemination (Waisbord, 2005). A considerable part of communication investments and activities were directed to mass media, high-level political advocacy, and some largely events-based attempts at social mobilization.

As polio cases persisted in some areas, with an increasing number of polio vaccine refusals, mainly in the three countries previously mentioned, a strategic reorganization was adopted. An example of this strategic reorganization is described by Olufowote (2011), who explains how it was possible to identify the local cultural influences of polio vaccine acceptance, using the culture-centered approach to health communication. The author also pointed out some sociological barriers to vaccine acceptance such as rumors and mistrust in local community leaders and authorities. Finally, he stressed the importance to consider the cultural context while designing any health communication plan. The local cultural context also extends to the role of religious leaders who need to get involved to ensure success for any health promotion intervention (Warraich, 2009).

These observations led the GPEI stakeholders to become aware of the increasing role that health communication could play at large, beyond the use of mass media, in achieving polio eradication. Other aspects of health communication strategies such as advocacy and interpersonal communication were then increasingly used. A work by Waisbord (2005) explains the reasons why the approach to health communication based on mass media

largely contributed in polio eradication in some settings like Latin America. The findings led to conclusion that people living in these settings had positive social attitudes towards immunization and expressed high demand for the vaccine. However, the work specified that the limitations of such strategy became obvious when the GPEI was launched in other regions of the world since that strategy failed to reach two kinds of populations: those with scarce or no access to conventional means of information and those who refused or resisted the oral polio vaccine.

In addition to the culture-centered approach to health communication, an increasing attention was put on the use of social and behavioral data collected from the populations who were targeted by the polio campaigns. The use of the data led to the improvement in the planning, implementation, and monitoring and evaluation of the interventions to promote polio vaccination (Taylor & Shimp, 2010). Some evaluation focused primarily on process—numbers of posters printed, number of persons trained, number of community events held—whereas others focused on answering the question, ‘‘did the desired outcome occur?.’’

One can note that the systematic review did not identify any polio vaccine promotion intervention calling upon the behavior change theories falling in the categories of the value-expectancy theories, the models of perceived threat and fear appeals, the stages models for health promotion, or the social cognitive theory or the diffusion of innovations theory. These results raised the questions on the relevance of these theories for such intervention. Further research is needed to answer these questions. Nevertheless, examples exist of research, albeit not related to the GPEI, which report on interventions to promote immunization programs based on some of these theories. Works by Askelson et al. (2010), and Bodenheimer, Fulton, & Kramer (1986) report in articles which describe the development of interventions to promote respectively Human Papillomavirus based on the Theory of Planned Behavior, and to promote Hepatitis B vaccine based on the Health Belief Model. On the other hand, there exist some core resistant groups to polio vaccine in specific areas such as Pakistan, Afghanistan and Nigeria. Actions from these resistant groups result sometimes in violence against vaccinators, and even murder (WHO, 2016). This situation is likely to

threaten the achievement of the GPEI's goal to eradicate polio soon. Toward these most resistant groups, there is a need to use more innovative approaches. As such, there might be a room for implementation of interventions calling upon value-expectancy theories, perceived threat and fear appeals models, stages models for health promotion, Social Cognitive Theory or Diffusion of Innovations Theory. For example, the stages model for health promotion associated with strategies drawn from social marketing may help in audiences segmentation based on the staging process, and eventually, help in designing interventions depending on the stages in which people are identified to be. Likewise, Diffusion of Innovations Theory may help in the increasing use of social media and social networks in particular in areas where security threats are created by core resistant groups. These social media and social networks provide the advantage of reaching people beyond the boundaries without physical contact. From this perspective, social media and social networks appear to be the preferred channels to spread polio vaccine-related information directly to the population outside the influence of community leaders.

Recommendations and Capstone Product

As mentioned early in this work, 27 cases of polio caused by the wild polioviruses and 3 cases of vaccine-derived poliomyelitis were discovered across the world and the GPEI stakeholders were notified as of October 2016 (WHO, 2016). As long as there will be a single polio case, immunization campaigns are required to stop human-to-human transmission of the disease. This implies that the continuation of communication efforts to keep the population involved is needed. Even in cases that eradication is achieved, efforts should continue to maintain the immunization coverage high enough to avoid any polio resurgence, and decrease the burden of other vaccine-preventable diseases within robust routine immunization programs. Theory-driven behavior change and communication interventions may still be of help in ensuring people's adherence to subsequent rounds and avoid campaigns fatigue. Having this in mind, one can recommend the following:

- Put in place a systematic behavioral and social science data collection process to enable the use of evidence-based and theory-driven approaches to design interventions.
- Expand the use of interpersonal communication and social mobilization approaches at all levels, and not only within communities, with required budget allocation to conduct activities to reach the maximum number of people to ensure intervention effectiveness.
- Best practices and lessons learned on how to overcome social resistances should be documented following a rigorous process (i.e. peer-reviewed), recorded, and made available to scientists in order to make their use and sharing easier for other public health challenges, such as the elimination of measles and malaria.
- The increasing development of social media and social networks should be exploited in a way that could contribute in designing effective and innovative interventions to promote polio vaccines and overall immunization activities.

At this point, it appears useful to link these recommendations to the context of the immunization system in Côte d'Ivoire. In this middle-income sub-Saharan country located in West Africa (figure 2), there exists a 38 year-old expanded program of immunization. This program targets 861,112 children aged 0-11 months in the year 2016 (DCPEV, 2015).

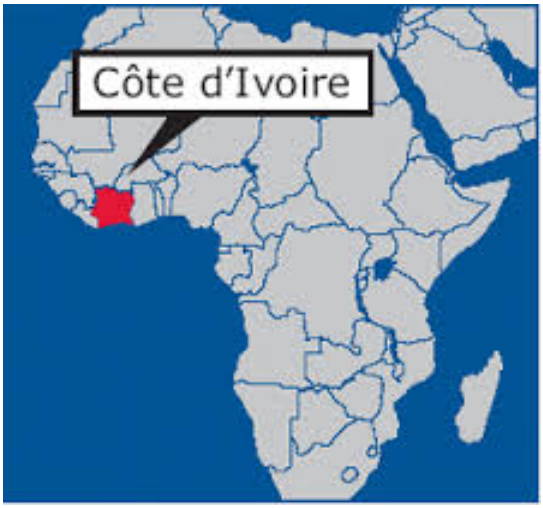

Figure 2: Map of Côte d'Ivoire within Africa
(Source: www.google.com/search)

Health authorities were notified of the last polio case in 2012. However, key indicators such as the third dose of diphtheria, pertussis, and tetanus-containing vaccine (DPT3), the third dose of oral polio vaccine (OPV3), and the first dose of measles-containing vaccine (MCV1) remained below 90% over the past five years (WHO, 2016c) as shown in Table 2 below. This is the recommended level in the global vaccine action plan (WHO, 2013). This situation, which is observed despite important financial resources investments in the health care system as part of the 2010 post-crisis rehabilitation process, put the country at risk of polio and measles outbreak any time.

Table 2: MCV 1 and OPV3 coverage from 2011 to 2015

	2015	2014	2013	2012	2011
MCV1	82	72	85	85	49
OPV3	88	85	98	94	58

(Source: WHO, 2016)

Consequently, there is a need to implement evidence-based health promotion strategies and best practices to contribute in the improvement of the overall immunization coverage. For this purpose, it should be relevant to:

- Use ecological approaches through data generation and multi-level analysis, to identify social etiologies of the persistent low vaccine rate. For this purpose, research institutions such as the national public health institute, which is the main public health research center within the ministry of health, have the required human resources and researchers.
- Conduct rigorous need assessments as well as situation and audience analyses, using models such as PRECEDE-PROCEED, following the multi-level analysis.
- Choose the type of intervention based on the results of the situation and audience analyses, and based also on the objectives to be achieved. Indeed, the findings from this systematic review suggest that when it comes to raise awareness, track rumors, and successfully address controversy and mistrust about vaccine, interventions grounded on health promotion intervention analysis and planning frameworks are

suitable. Similarly, where there is a need to increase support from local community and religious leaders, and increase knowledge and attitude changes towards immunization, communication theory for public health frameworks should be the preferred choice.

Limitations

These findings are subject to at least two limitations that need to be taken in account. First, although the types and number of databases used for the literature search were recommended by an experienced librarian, they were not meant to be exhaustive. Yet, these nine databases were the most likely to provide articles relevant to the topic. Second, the documentation included in the systematic review was restricted to articles published in peer-reviewed journals. As a result, a number of documents, such as reports and conference proceedings, were excluded from the review. So it is not a comprehensive assessment of what was implemented within the GPEI during the time frame we have considered. The resources excluded could have been helpful in providing an overview of what other GPEI partners have accomplished as part of their contribution to the polio eradication.

In spite of these limitations, this work scratches the surface and helps to open doors for further research.

Conclusion

Thanks to the work of the global health community, polio is closer than ever to being eradicated. Hopefully, this infectious disease will be the second to be eradicated after the successful experience with smallpox. By achieving polio eradication, thousands of children will have their lives saved. While celebrating its 28th anniversary in the year 2016, it is important to point out the significant role the global polio eradication initiative played towards this achievement. This role covers coordinating efforts, making vaccine and supplies available, ensuring financing and service delivery as well as communication and behavior-change interventions. This systematic review aimed to provide an overview of whether health promotions interventions were used to contribute to polio eradication. The time period

covered, ranging from 2000 to 2014 is also the time period when the shift occurred in terms of communication strategies. The shift was from media-based interventions to more culture-centered interventions. Based on the fact that only peer-reviewed articles were included, a number of documents that report other significant contributions may have been missed. At least, this work appears as a good starting point to conduct further research over a larger period of time with various type of documentation. To take better advantage of the implementation of the GPEI, and contribute fully to the polio legacy in terms of immunization promotion activities, conducting a review that encompasses documentations available since the launch of the initiative in 1988 could be one way to address the issue.

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