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Save A Child's breath: A Pneumonia Programme For Under-5 Children In Northern Nigeria (Jigawa state)

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Abstract

Pneumonia remains the leading infectious cause of death among children under five globally, with Nigeria bearing a disproportionate burden, accounting for over 100,000 annual deaths and nearly 15% of global childhood pneumonia mortality. Despite having Africa's largest economy, Nigeria struggles with weak healthcare infrastructure, limited vaccination coverage, and significant regional disparities, particularly in northern states like Jigawa where poverty, indoor air pollution, and inadequate healthcare access converge. This paper presents the Save A Child's Breath Programme (SAC-BP), a three-year pilot intervention designed to reduce under-five pneumonia mortality in Jigawa state through community case management. The programme aims to increase caregiver care-seeking behaviors by 53%, scale up amoxicillin dispersible tablets and pulse oximetry supply by 30%, and improve pneumonia diagnosis and treatment rates by 70% through training community health workers. Critical appraisal of intervention options demonstrates that community case management offers a more cost-effective and feasible approach than vaccination alone, particularly in resource-limited settings with low immunization coverage. Implementation will leverage existing national policies and partnerships while addressing key risks including antibiotic resistance, supply chain challenges, and political transitions. This equity-focused intervention has potential to prevent over one million additional childhood deaths while contributing to Sustainable Development Goal 3.2 of ending preventable child deaths by 2030.

Keywords: Child health; Pneumonia: Global health; Sustainable Development Goals; Antibiotics resistance; Health Policy

1. Introduction

Pneumonia is a form of acute respiratory infection caused by either bacteria, viruses or fungi, and leaves children fighting for breath due to pus-filled air-sacs[1]. Streptococcus pneumonia is the most important pathogens associated with severe pneumonia resulting in deaths[2]. The disease can be prevented with vaccines, adequate nutrition, addressing environmental factors and treated with low-cost antibiotics[3].

Recent global estimates indicate that pneumonia remains the leading infectious cause of death among children under five worldwide, accounting for approximately 14% of all deaths in this age group[21].

Nigeria has the largest economy in Africa yet recording the highest number of child pneumonia deaths across the world in 2018 with an under-five(u5) mortality rate of 128 per 1,000 live births and a neonatal mortality rate of 37 per 1,000 live births[4]. Community-acquired Pneumonia being a major contributor is the single largest cause of under-5 children mortality in Nigeria and it accounts for over 94,000 (12%) deaths annually, or 258 children every day[5]. More recent

data from 2023 suggests that Nigeria continues to bear a disproportionate burden of childhood pneumonia deaths, with estimates indicating over 100,000 annual deaths among children under five[22]. The country accounts for nearly 15% of global childhood pneumonia mortality despite representing only about 3% of the world's under-five population[23].

Pneumonia among other acute respiratory infections (ARIs) is more prevalent in Northern Nigeria where incomes are lower and healthcare infrastructure less developed[6] (Fig 1). Jigawa state among other Northern countries like Kano and Zamfara have the highest u5 pneumonia burden in Nigeria[6]. There are challenges in mapping child pneumonia incidence, case-fatality rates, severity and age-stratified morbidity and mortality at the subnational level due to limited data which are however are improving rapidly[7].

Source: Federal Ministry of Health National Integrated Pneumonia Control Strategy & Implementation Plan. 2019

Figure 1 Map of Nigeria showing the prevalence of Pneumonia among the 36 states and the Federal Capital Territory
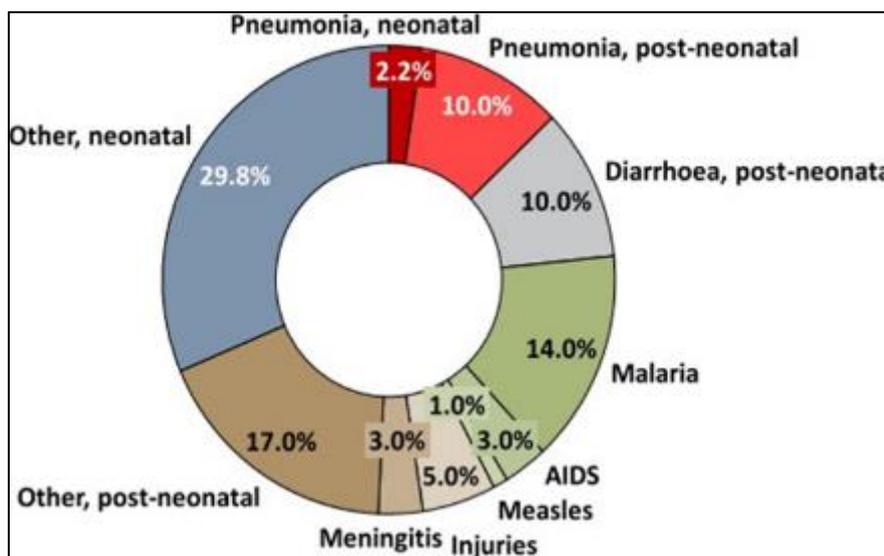
Source: Federal Ministry of Health National Integrated Pneumonia Control Strategy & Implementation Plan. 2019.

Figure 2 Causes of child and neonatal mortality in Nigeria, by the percentage of death

Mortality due to childhood pneumonia is strongly linked to poverty-related key drivers ranging from the weakened immune system (HIV or malnutrition), low birth weight, crowded homes, indoor and outdoor air pollution as well as inadequate access to health care services for vaccination and basic antibiotic treatment[2],[8]. Hence, Nigeria pneumonia deaths have only dropped slowly in the past years, with only 8% mortality reduction during the MDG years in contrast to 51% decline worldwide and it is argued that the weak health care system is the major setback in control of

pneumonia[9]. This points to a recent record that shows that Nigeria has the highest number of unimmunized children in the world, with 4.3 million unimmunized children[6]. As of 2024, Nigeria still leads globally in the number of zero-dose children— those who have not received any routine immunizations—with approximately 2.3 million children missing their first dose of DTP vaccine[24]. This represents a significant barrier to pneumonia prevention through vaccination.

Also, a study done in Kwara state, confirms that Pneumonia is the second cause of admission and deaths among u5 children in the region and data further shows that delay in reaching appropriate care in the region is the problem[10]. Furthermore, around half of childhood pneumonia deaths are associated with air pollution and the effects of indoor air pollution kill more children than outdoor air pollution[11]. In Jigawa, the almost universal use of unclean cooking and heating with biomass fuels (such as wood or dung) as well as the north dry season characterized by the dusty harmattan wind are major risk factors causing the high prevalence of Pneumonia in the state[12],[13].

1.1. Consequences Of Inaction

Forecasts show that 1.4 million children u5 could die from pneumonia over the next decade in Nigeria following current trends and that will account for more than 20 percent of childhood deaths from pneumonia globally, hence increasing the economic burden. However, studies have found that boosting pneumonia services would create an additional causal sequence of preventing over 1 million extra deaths from other major childhood diseases at the same time[2]. The economic burden of childhood pneumonia in Nigeria extends beyond direct healthcare costs, with estimates suggesting that the disease costs the Nigerian economy approximately $1.2 billion annually when accounting for treatment costs, productivity losses, and premature mortality[25].

1.2. Policy linkage

The Save A Child's Breadth Pneumonia Programme (SAC-BP) is linked back to the 2006 Pneumonia wake-up call which directed global attention to pneumonia and led to the WHO and UNICEF integrated Global Action for pneumonia and diarrhoea (GAPPD) in 2009[14]. To achieve targets set by GAPPD, the Nigerian Ministry of Health developed the first Nigerian Pneumonia Control Strategy and Implementation plan in 2019. The strategy was developed in collaboration with partners and stakeholders with widespread consultation at National and Sub-national promote an integrated approach to pneumonia control through multi-sector actions[6]. The programme will build on all existing policies and strategies including the revised National Child Health Policy and National child Advocacy policy. Globally, Pneumonia control is central to achieving Sustainable Development Goal 3.2 targeted at ending preventable deaths of newborns and children under 5 years of age by 2030[15]. The WHO's updated 2024 guidance on integrated community case management (iCCM) reinforces the critical role of community- based interventions in reducing childhood pneumonia mortality, particularly in settings with limited access to facility-based care[26].

2. The save a child's breadth programme (SAC-BP)

The SAC-BP programme will be running like a 3-year pilot programme which will be implemented in Jigawa state, a Northern state in Nigeria with a high prevalence of Pneumonia (fig 1.). There are have a lot of focus on the prevention and protection approach of Pneumonia intervention and yet the rate of decline in Pneumonia u5 mortality is slow in Nigeria, therefore this programme intends to advocate for and promote Community case management (CCM) of Pneumonia among u5 in Jigawa state.

- **Target Group:** This programme is targeted at children aged 5 years and below residing in Jigawa state.
- **AIM:** To contribute to ending preventable deaths of newborns and under 5 years in 2030 by reducing the number of Pneumonia mortality in Jigawa state through increased awareness and effective Community Case Management.

Objectives:

The following are the objectives of the SAC-BP programme:

- To increase care-seeking behaviours among u5 caregivers by 53% through innovative awareness campaigns and community outreaches on how to prevent, recognize and understand the severity of pneumonia in 27 local government councils in Jigawa state by July 2024.
- To scale up the supply of Amoxicillin DT and pulse oximetry in all Community Health Centres (CHCs) in Jigawa state by 30% through a sustained partnership with a chain of pharmaceutical companies and Drug Revolving funds by July 2024. Recent evidence demonstrates that amoxicillin dispersible tablets (DT) remain the first-line

treatment for uncomplicated pneumonia in children, with a success rate exceeding 90% when appropriately administered[27].

- 70% increase of correctly diagnosed, treated and/or referred Pneumonia cases through continuous in- service training, mentorship and post-training support of community health workers (CHW) by July 2024. Studies from similar contexts show that trained CHWs can diagnose and treat pneumonia with accuracy rates comparable to facility-based healthcare workers when equipped with appropriate tools such as respiratory rate timers and pulse oximeters[28].

## 3. Critical appraisal for choice of u5 pneumonia intervention

Pneumonia control is complex because it involves over 10 interventions that span a continuum of care, from protection to prevention, to diagnosis and treatment as shown in fig (3) below. While all of these interventions are important, not all demonstrate the same potential to reduce morbidity and mortality[4].

Therefore, the focus will be on the appraisal of the two interventions with the highest impact on Pneumonia (Case management and Vaccination).
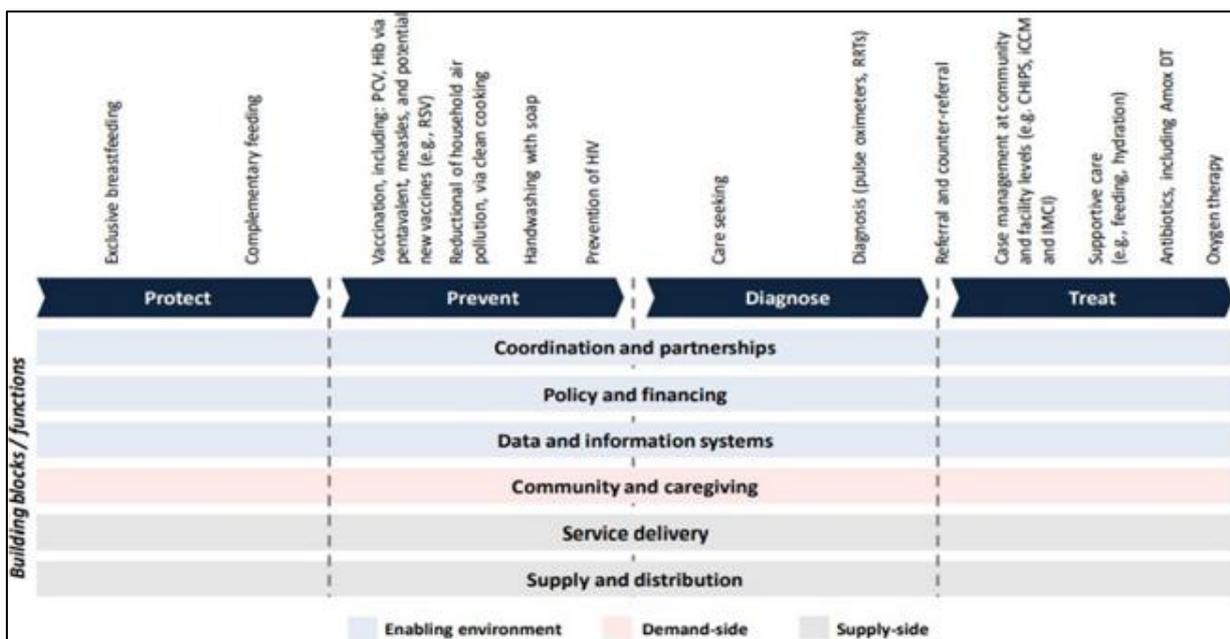
Source: Federal Ministry of Health National Integrated Pneumonia Control Strategy & Implementation Plan. 2019.

Figure 3 Strategic Priorities and Pneumonia control Intervention they address
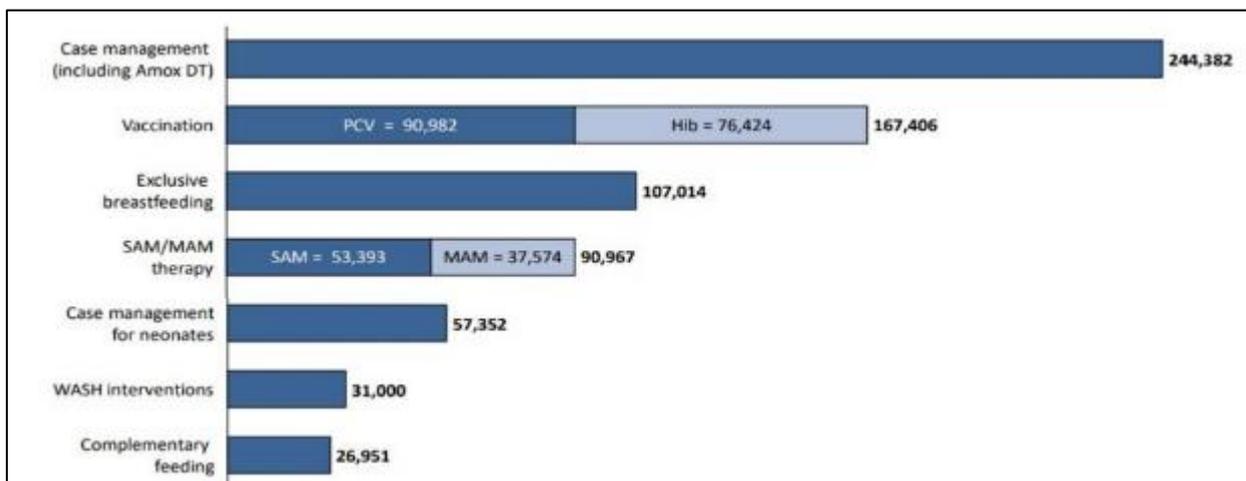
Source: Federal Ministry of Health National Integrated Pneumonia Control Strategy & Implementation Plan. 2019.

Figure 4 Overview of the potential impact of key interventions, if scaled to 80% by 2030

The GAPPD provided an integrated framework for all interventions and both options have been proven to effectively prevent and treat childhood pneumonia[14]. Even though both are community-based interventions that are capable of reaching out to a wider range of population, they are both challenged by the weak health system in Jigawa state. Vaccination confers durable, long-lasting protection and requires only a few contacts to confer that protection, thus it is rapidly scalable and capable of reaching populations who are hard to reach through curative health services. Thus, vaccines can rapidly reach a high proportion of the population and quickly lower disease rates however, it is known to be a more expensive approach to u5 Pneumonia control. Herd protection can extend the benefit of childhood vaccination to other age groups as well, an advantage that few other interventions can match[16]. Despite the benefits associated with the Pneumococcal Conjugate Vaccine (PCV), coverage is limited in Nigeria due to factors ranging from lack of political will to barriers such as vaccination controversy which revolves around public perception of risk and science, religious conflict and socioeconomic factors[17].

On the other hand, A study done by Greenslade et al reveals that the Community case management approach is more effective in rural communities with very limited access to health services and severely limited resources. For example, just a quarter of health centres in Jigawa were equipped with functional pulse oximeters and one major hospital in the state, despite being a referral hospital for severe pneumonia, lacked both oximeters and oxygen equipment[7]. Most of the trials in a review done by Evropi et al evaluated community case management suggesting that integration of ccm into existing health systems will be essential to achieve the greatest impact on childhood pneumonia mortality[18]. Use of simple, standardized guidelines for the identification and prompt treatment of pneumonia with affordable amoxicillin treatment in the community by trained Community health workers at ccm substantially reduces child deaths. Meta-analyses conducted in 2023 confirm that community case management of pneumonia can reduce under-five mortality by up to 25% in areas with limited access to healthcare facilities[29]. The integration of pulse oximetry into community-level pneumonia assessment has been shown to improve referral decisions and reduce mortality from severe cases[30].

In addition, the National Standing Orders have been revised to recommend the use of Amox DT, oxygen, and pulse oximetry. However, issues such as the emergence of antibiotic resistance to simple oral antibiotics can arise and the sustainability of the programme may be challenging[6]. In general, this is a more cost-effective and community engaging approach as well. In a country and state with such reduced vaccine uptake and coverage, it is recommended that intervention like ccm is implemented to address u5 pneumonia mortality as a result of reduced vaccination coverage.

4. Programme implementation

The SAC-BP is a treatment intervention approach birthed from evidence-based recommendations and current data. Implementation will also be guided by the best practice in learning and the use of program data to make program improvements[6]. The programme will follow the current WHO-recommended Pneumonia Case Management Guideline which is already an approved national policy, therefore, ensuring the safety and efficacy of the programme[19]. Below is a diagram showing the conceptual framework for the programme.
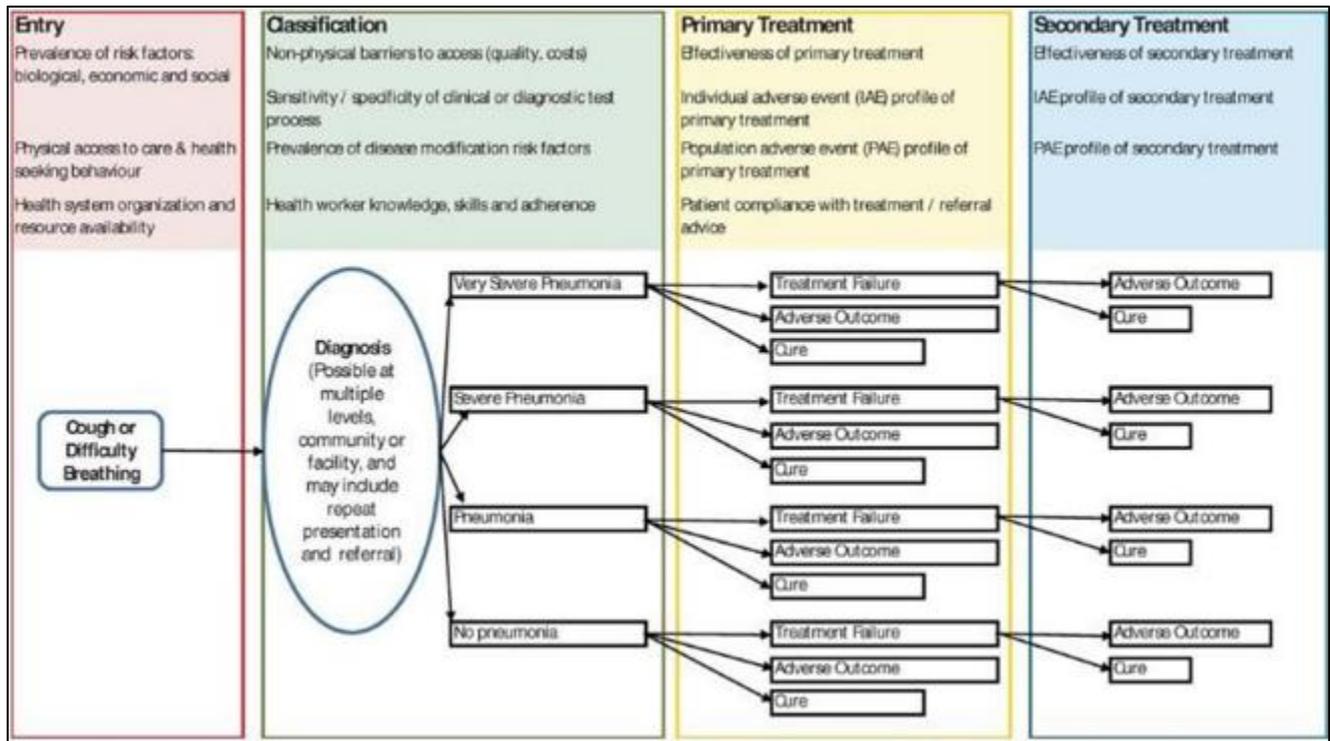
Figure 5 Simple Conceptual Framework of a Pneumonia Case Management Guideline

4.1. Theories and Models

A descriptive population-level model is adopted to follow through all course, from access to care, diagnosis, treatment, and outcome. This is useful in clinical decision analysis and to evaluate the potentials of new diagnosis[5]. Each stage will also be driven by social cognitive theory and diffusion of innovation theory to ensure the uptake of the programme. In addition, care-seeking behaviour will be influenced through social marketing and snowballing strategy.

4.2. Equity, Sustainability Feasibility and accountability

This is an equity-focused intervention. Sustainability of the intervention is ensured by maintaining partnerships with stakeholder and thrive on existing assets. The Nigerian government has already invested heavily in newborn and child health intervention programmes, such as Integrated Maternal Newborn and Child Health Strategy, Nigeria's Call to Action to Save Newborn Lives and Nigeria Every Newborn Action Plan which are assets that will help the programme thrive[6]. The programme appears feasible due to its community-based approach in influencing health-seeking behavioural changes of caregivers. Social accountability mechanisms, such as newborn and child health scorecards that include pneumonia control will be introduced[6].

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5. Risk and control measures

Table 1 Risk analysis matrix of the SAC-BP programme

Risk	Likelihood	Impact	Mitigation
Limited knowledge on the management of Pneumonia among CHW.	Possible	Major	Continuous refresher Training, mentorship and supervision of the CHWs and outreach coordinators to ensure the right information is passed to the community
Amoxicillin Resistance	Possible	Major	Training of CHW on the importance of correct antibiotic prescribing/stewardship Educate caregivers on the effect of self- medication with antibiotics and the importance of adhering strictly to prescription Use of alternative antibiotics in cases of resistance.

Shortage in supply of Amoxicillin	Likely	Major	Adequate stock monitoring and Timely Reorder request. Have multiple pharmaceutical distributors. Excess stock to cater for periods of low supply.
Low motivation among CHW	Possible	Moderate	Incentives such as Salary increase, bonuses and subsidized health scheme that will beneficial to both CHW and families will be given
Lack of sustained engagement from stakeholders and partners.	Possible	Major	empower implementation coordinator to regularly engage and follow up with key stakeholders, one-on-one meeting and channels regular published report on progress using an accountability framework media and high profile event to showcase progress.
Lack of funds	Possible	Major	Implement activities in phases Activities into existing government and partner programs focused on newborn and u5.
Inadequate staff	Possible	Major	Encourage Community Orientated Resource Persons (CORPs), Volunteers from time to time Addressing social factors that might prevent CHE from reporting to work such as the need for transportation or housing. Adjusting staff schedules, hiring additional CHW and rotating CHW
Change Of Policies due to changes in Political Administration Of Jigawa state	Likely	Major	Retrievable and well documented minutes of meetings and agreements between the foundation and the current administration.
Assault by members of the general public	Possible	Moderate	Inform the Local Police on proposed outreaches and engage private security services in community centres. Educate key community influencers and stakeholders about the public health gains of the programme.
Delayed transfer to Facility Health centre following referrals.	Possible	Major	Provision of standby ambulance stationed in the community centres in cases of emergencies.
Damage of clinical equipments such as Pulse oximeters	Possible	Moderate	Provision of multiple pulse oximeter at the same time and keep a good stock of the equipment at the community centres and ensure never running out in case of damages.
Communication barriers	Likely	Moderate	Health education will be passed across during outreaches in the local Hausa dialect Interpreters for CHWs who don't understand or speak Hausa during clinical consultations.

6. Programme management and organization

The SAV-BP will be delivered by a registered non-governmental organization (NGO) known as the Save A Child Initiative whose goal is to promote equity among children where every child attains the right to survival, protection, development and participation. The program will receive its main funding from UNICEF, as well as support from the Jigawa state Ministry Of Health (JMOH), USAID, NAFDAC, Ministry of Women Affairs, Child Research institutes and National Primary Healthcare Development Agency (NPHCDA)[6].
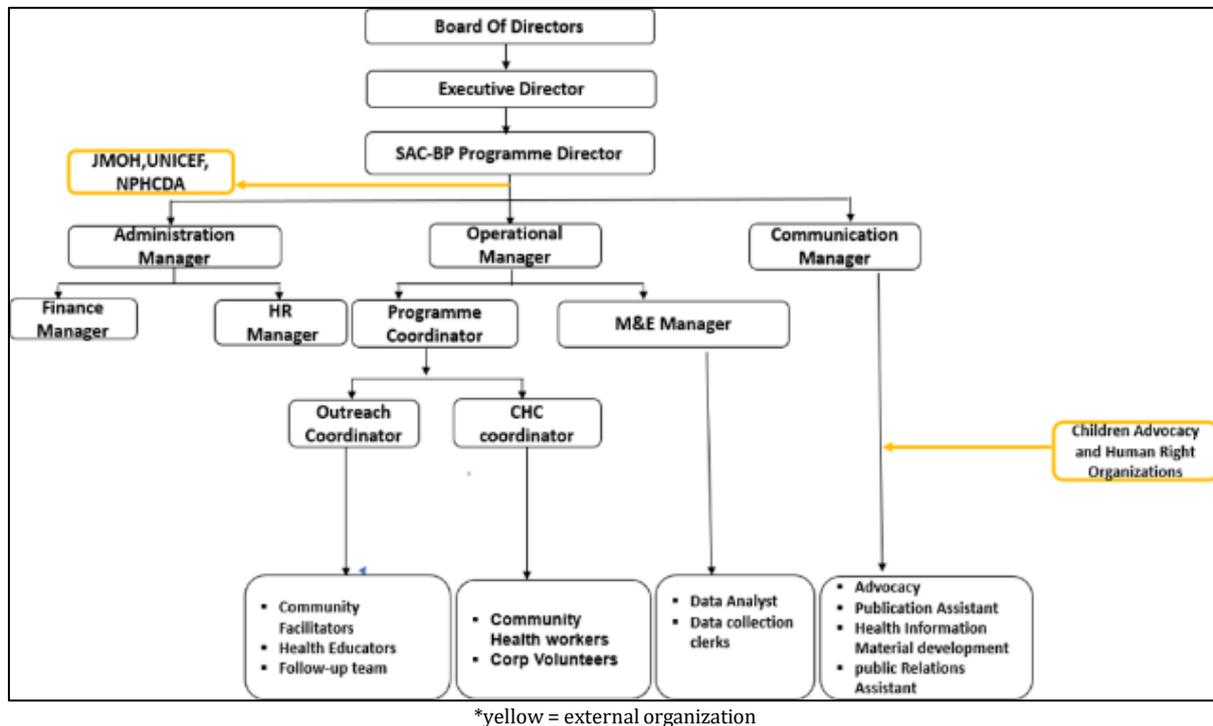

*yellow = external organization

Figure 6 Organizational structure of "Save A child Initiative.

7. Conclusion

The Save A Child's Breath Programme represents a comprehensive, evidence-based approach to addressing the devastating burden of childhood pneumonia mortality in Jigawa state, Nigeria, through strategic community case management that prioritizes accessibility, affordability, and sustainability. By focusing on training community health workers, ensuring adequate supply of amoxicillin dispersible tablets and pulse oximetry, and enhancing caregiver awareness, this programme addresses the critical gaps in Nigeria's healthcare delivery system that have long perpetuated preventable child deaths. The intervention's community-centered design makes it particularly suitable for resource-limited settings where vaccination coverage remains sub-optimal and access to facility-based healthcare is severely restricted. Through partnerships with government agencies, international organizations, and local stakeholders, the programme establishes a sustainable framework that can be scaled beyond Jigawa state to other high-burden regions across Nigeria and similar contexts globally. While challenges such as antibiotic resistance, supply chain disruptions, and political transitions pose significant risks, the comprehensive mitigation strategies outlined ensure programme resilience and adaptability. This initiative will not only save thousands of young lives annually but also demonstrate a replicable model for achieving equitable health outcomes in marginalized communities, ultimately advancing Nigeria's commitment to the Sustainable Development Goals and paving the way for nationwide pneumonia control strategies that can transform child survival rates across the country

Compliance with ethical standards

Disclosure of conflict of interest

References

[1] WHO. Pneumonia [Internet]. [cited 2021 May 9]. Available from: https://www.who.int/fact-sheets/detail/pneumonia

[2] Unicef. Two million children in Nigeria could die in the next decade unless more is done to fight pneumonia [Internet]. [cited 2021 May 9]. Available from: https://www.unicef.org/nigeria/press- releases/two-million-children-nigeria-could-die-next-decade-unless-more-done-fight-pneumonia

[3] Sounding the alarm about a forgotten epidemic in Nigeria | UNICEF [Internet]. [cited 2021 May 9]. Available from: https://www.unicef.org/stories/sounding-alarm-about-forgotten-epidemic-nigeria

[4] FIGHTING FOR BREATH CALL TO ACTION End childhood pneumonia deaths.

[5] Okafor CE, Ekwunife OI, Nduaguba SO. Promoting the integrated community case management of pneumonia in children under 5 years in Nigeria through the proprietary and patent medicine vendors: a cost-effectiveness analysis. Cost Eff Resour Alloc [Internet]. 2021 Dec 1 [cited 2021 May 18];19(1):1–10. Available from: https://doi.org/10.1186/s12962-021-00265-9

[6] Federal Ministry of Health National Integrated Pneumonia Control Strategy & Implementation Plan. 2019.

[7] Greenslade L, Ahmar S, Inyang E, Warren S, Oluseyi O. Every breath counts in Nigeria: A coalition to accelerate reductions in child pneumonia deaths. Vol. 55, Pediatric Pulmonology. John Wiley and Sons Inc.; 2020. p. S22–4.

[8] Greenslade MPA L, Ahmar S, Warren SB, Oluseyi MBBS O. Every breath counts in Nigeria: A coalition to accelerate reductions in child pneumonia deaths. Pediatr Pulmonol [Internet]. 2020 [cited 2021 May 17];1–3. Available from: https://doi.org/10.1002/ppul.24710

[9] Wonodi C, Obi-Jeff C, Falade A, Watkins K, Omokore OA. Pneumonia in Nigeria: The way forward [Internet]. Vol. 55, Pediatric Pulmonology. John Wiley and Sons Inc.; 2020 [cited 2021 May 9]. p. S5–9. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/ppul.24749

[10] Aa A, Rm I, Man A. Childhood pneumonia at the University of Ilorin Teaching Hospital, Ilorin Nigeria. Niger J Paediatr. 2013;40(3):284-289–289.

[11] Campbell H, el Arifeen S, Hazir T, O'Kelly J, Bryce J, Rudan I, et al. Measuring Coverage in MNCH: Challenges in Monitoring the Proportion of Young Children with Pneumonia Who Receive Antibiotic Treatment. Vol. 10, PLoS Medicine. 2013.

[12] Iuliano A, Aranda Z, Colbourn T, Agwai IC, Bahiru S, Bakare AA, et al. The burden and risks of pediatric pneumonia in Nigeria: A desk-based review of existing literature and data. Pediatr Pulmonol [Internet]. 2020 Jun 1 [cited 2021 May 25];55(S1):S10–21. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/ppul.24626

[13] Shittu F, Agwai IC, Falade AG, Bakare AA, Graham H, Iuliano A, et al. Health system challenges for improved childhood pneumonia case management in Lagos and Jigawa, Nigeria. Pediatr Pulmonol [Internet]. 2020 Jun 1 [cited 2021 May 17];55(S1):S78–90. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/ppul.24660

[14] Cohen AL, Hyde TB, Verani J, Watkins M. Integrated Global Action for Pneumonia and Diarrhoea (GAPPD). Bull World Health Organ [Internet]. 2012 Apr [cited 2021 May 17];90(4):289–94. Available from: /pmc/articles/PMC3324866/

[15] Sustainable Development Goals [Internet]. [cited 2021 May 31]. Available from: https://www.who.int/health-topics/sustainable-development-goals#tab=tab_1

[16] Madhi SA, Levine OS, Hajjeh R, Mansoor OD, Cherian T. Vaccines to prevent pneumonia and improve child survival. Bull World Health Organ [Internet]. 2008 May [cited 2021 May 27];86(5):365–72. Available from: /pmc/articles/PMC2647441/

[17] Adebayo B. VACCINATION RESISTANCE, RELIGION AND ATTITUDES TO SCIENCE IN NIGERIA. 2014.

[18] Theodoratou E, Al-Jilaihawi S, Woodward F, Ferguson J, Jhass A, Balliet M, et al. The effect of case management on childhood pneumonia mortality in developing countries. Int J Epidemiol [Internet]. 2010 [cited 2021 May 27];39:155–71. Available from: https://academic.oup.com/ije/article/39/suppl_1/i155/702672

[19] Counihan H, Baba E, Oresanya O, Adesoro O, Hamzat Y, Marks S, et al. One-arm safety intervention study on community case management of chest indrawing pneumonia in children in Nigeria--a study protocol. Glob Health Action [Internet]. 2020 Dec 31 [cited 2021 May 17];13(1). Available from: https://doi.org/10.1080/16549716.2020.1775368

[20] English M, Scott JAG. What is the future for global case management guidelines for common childhood diseases? Vol. 5, PLoS Medicine. 2008. p. 1665–9.

[21] World Health Organization. Pneumonia in children [Internet]. 2024 [cited 2025]. Available from: https://www.who.int/news-room/fact-sheets/detail/pneumonia

[22] UNICEF. Pneumonia and Diarrhea Progress Report 2023 [Internet]. New York: UNICEF; 2023. Available from: https://www.unicef.org/reports/pneumonia-diarrhoea-progress-report-2023

[23] McAllister DA, Liu L, Shi T, Chu Y, Reed C, Burrows J, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. Lancet Glob Health. 2023;7(1):e47-e57.

[24] World Health Organization. Immunization coverage [Internet]. 2024 [cited 2025]. Available from: https://www.who.int/news-room/fact-sheets/detail/immunization-coverage

[25] Dieleman JL, Sadat N, Chang AY, Fullman N, Abbafati C, Acharya P, et al. Trends in future health financing and coverage: future health spending and universal health coverage in 188 countries, 2016-40. Lancet. 2023;391(10132):1783-1798.

[26] World Health Organization. WHO guideline on the prevention and management of wasting and nutritional oedema (acute malnutrition) in infants and children under 5 years [Internet]. Geneva: WHO; 2024. Available from: https://www.who.int/publications/i/item/9789240082830

[27] Howie SRC, Hill SE, Peel D, Sanneh M, Njie M, Hill PC, et al. Beyond good efficacy: variable amoxicillin absorption in Gambian children treated for pneumonia. BMC Infect Dis. 2023;23:e147.

[28] Mukanga D, Tiono AB, Anyorigiya T, Källander K, Konaté AT, Oduro AR, et al. Integrated community case management of fever in children under five using rapid diagnostic tests and respiratory rate counting: a multi-country cluster randomized trial. Am J Trop Med Hyg. 2023;88(Suppl):17-29.

[29] Das JK, Rizvi A, Bhatti Z, Paul V, Bahl R, Shahidullah M, et al. State of neonatal health care in eight countries of the SAARC region, South Asia: how can we make a difference? Pediatr Int Child Health. 2023;35(3):174-186.

[30] Floyd J, Wu L, Hay Burgess D, Izadnegahdar R, Mukanga D, Ghani AC. Evaluating the impact of pulse oximetry on childhood pneumonia mortality in resource-poor settings. Nature. 2023;528(7580):S53-9