MEDTRONIC **LABS**

FROM DETECTION TO DISEASE CONTROL

A CASE STUDY OF BETTE LYFE (BETTER LIFE): A DIGITAL-ENABLED COMPREHENSIVE HYPERTENSION AND DIABETES CARE PROGRAM IN SIERRA LEONE

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Executive Summary

Sierra Leone faces a silent epidemic of non-communicable diseases that threatens to overwhelm its fragile health system. With 62% of persons with hypertension remaining undiagnosed and only 9% achieving adequate control, alongside one of the highest rates of undiagnosed diabetes globally at 78.7%, the country exemplifies the NCD crisis in sub-Saharan Africa. The Bette Lyfe (Better Life) program demonstrates how end-to-end, digital technology-enabled models can transform chronic disease care even in severely resource-limited settings.

Implemented across 17 faith-based and public facilities (11 community health centres and 6 district hospitals) in four districts, Bette Lyfe architected a three-tier care ecosystem and referral pathway through strategic task-shifting/sharing and decentralization. By shifting screening from facility nursing staff to community health workers (CHWs) and empowering Community Health Officers at Community Health Centres to manage uncomplicated disease previously managed by physicians, the program addressed critical human resource limitations while maintaining coordinated care continuity.

The program supported the screening of 25,320 persons, identifying 39% with high blood pressure (BP) and 13% with blood glucose (BG) in the diabetes range. While the elevated BP rates align with WHO and STEPS survey adult prevalence estimates, the elevated BG rates exceed previously reported estimates, possibly due to the risk-based, targeted approach employed for diabetes screening. Through same-day clinical evaluation and shortened referral pathways, the program achieved 71% screening-to-enrolment conversion, eventually enrolling a total of 11,253 patients in structured hypertension and diabetes care.

Outcomes for patients with a documented follow-up rivalled high-income settings: hypertension control improved from 28% at enrolment to 66% at twelve months, with mean systolic BP reducing by 14.7mmHg ($p<0.001$). Diabetes control nearly tripled from 25% at enrollment to 71% at 12 months ($p<0.001$). However, the program data also revealed sobering realities about the challenges of maintaining sustained patient engagement in chronic disease management. With only 23% of patients with hypertension and 29% of patients with diabetes sustaining follow-up at six and twelve months, the findings highlight that achieving population impact demands innovation not only in case detection and linkage to care, but also in care continuity.

Bette Lyfe provides both a blueprint and cautionary tale for NCD programming in Africa. The program found disease, linked people to care, struggled with retention, but achieved good outcomes for those who stayed. The findings demonstrate that desirable chronic disease outcomes are achievable in low-resource environments when appropriate technology, community engagement, decentralized care and clinical protocols converge.

This case study examines the Bette Lyfe case study through multiple angles, offering frank assessments of both the highs and lows, while proposing pathways for institutionalizing and scaling the model.

THE EMERGING NCD CRISIS

Non-communicable diseases (NCDs) now account for 34% of all deaths in Sierra Leone,[1] threatening a health system already strained by infectious diseases and maternal health challenges. The country, still bearing scars from the Ebola outbreak that claimed 7% of the country's healthcare workers,[2] operates with only 1.3 and 11.6 doctors and nurses respectively per 10,000 population,[3] most of whom are concentrated in urban areas[4] while 59% of the population resides in rural areas with limited access to care.[5]

The economic dimensions are particularly acute. With out-of-pocket expenditure comprising 65% of health spending[6] and GDP per capita at $873,[7] chronic disease management costs create insurmountable barriers for most Sierra Leoneans. Facility-based care, traditionally the cornerstone of NCD management, cannot address the needs of a population scattered across difficult terrain with limited transportation infrastructure that becomes impassable during rainy seasons.[8]

'62% of persons with hypertension and 79% of those with diabetes in Sierra Leone remain undiagnosed.'

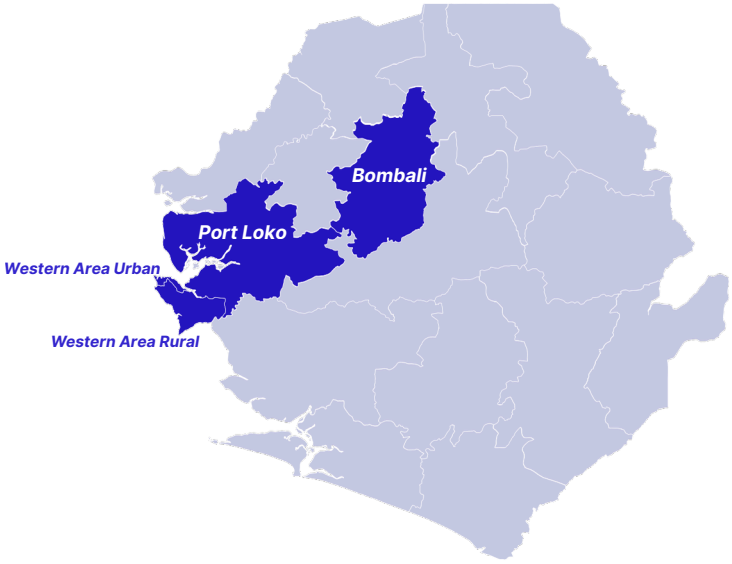
Against this backdrop, the inadequacy of conventional approaches to NCD care becomes starkly apparent. Facility-based opportunistic screening reaches only those who happen to seek care for other conditions, missing many asymptomatic individuals who will only present when complications have already developed. The limited number of healthcare workers cannot possibly provide the continuous, longitudinal care that chronic disease management demands. While Community Health Workers (CHWs) are trained to ask about NCD symptoms and risk factors,[9] they lack the equipment and training to conduct actual measurements essential for screening and monitoring. The result is a cascade of failure: 62% of patients with hypertension are undiagnosed, with just 9% of those diagnosed achieving control.[10] Even more worrying is the fact that Sierra Leone has among the highest rates of undiagnosed diabetes globally at 78.7%.[11]

This emerging crisis demands care delivery models that transcend geographic barriers, optimize scarce human resources, and create comprehensive, end-to-end systems that facilitate care pathways from community screening to facility-based treatment.

BETTE LYFE: DESIGNING FOR CONTEXT

Program scope

The Bette Lyfe program, implemented by Medtronic LABS in partnership with the Christian Health Association of Sierra Leone (CHASL), Sanofi Global Health, and the Sierra Leone Ministry of Health redesigned hypertension and diabetes care delivery through a decentralized, comprehensive and digital technology enabled approach. The program was implemented through 17 health facilities: 10 faith-based and 7 government-owned in Bombali, Western Area Urban, Western Area Rural and Port Loko districts (Figure 1). The program was launched in February 2022 with funding support for 18 months. The program was expected to sustain its gains beyond the project funding timeline.



Facility levels

11	Community Health Centres
6	District Hospitals

Number of facilities per district

7	Bombali
5	Western Area Urban
3	Western Area Rural
2	Port Loko

Figure 1 Program implementation site

Program Design Principles

Three core principles guided implementation:

- **Improving access:** Bringing screening and basic management closer to the population rather than expecting patients to navigate distant facilities.
- **Strategic task- shifting/sharing:**
  - Empowering CHWs to conduct BP and BG screening, a role traditionally done by facility nurses and laboratory personnel.
  - Strengthening the role of Community Health Officers (CHOs) at CHCs to manage and monitor uncomplicated hypertension/diabetes, a role traditionally reserved for doctors at district hospitals.
- **Technology as an enabler for system integration:** Enhancing existing service packages at all levels and streamlining referral pathways while creating digital linkages between them.

Model of Care: The Three Tier Care Cascade

Community-level detection

The program transformed CHWs from passive health promoters to active screeners through comprehensive training on biometric measurements using digital devices. The SPICE platform provided real-time decision support, automatically flagging elevated readings (Blood pressure-BP ≥140/90 mmHg, fasting blood glucose-FBG ≥7.0 mmol/L or random blood glucose-RBG ≥11.1mmol/L) and generating referrals. This task-shifting from facility nurses exponentially expanded screening reach while maintaining quality through standardized digital protocols. While hypertension screening was provided to the general adult (≥18 years) population, blood glucose testing was more targeted based on risk. The risk criteria was adopted from the WHO HEARTS Technical Package for Type 2 Diabetes and built into the SPICE platform (Age ≥40 years and/or overweight or obese and/or suggestive symptoms).[12]

Decentralizing and task-sharing care to Community Health Centres (CHCs)

CHCs were strengthened to implement existing guidelines, empowering CHOs to manage uncomplicated NCDs. Operationalization of these guidelines was effected through intensive training, SPICE-embedded clinical protocols providing real-time decision support and supervised practice. This task-shifting/sharing addressed the physician shortage crisis while ensuring protocol-driven care. The program's same-day clinical evaluation approach which included bringing complete medical teams to screening events minimized the temporal gap that typically causes patient loss between detection and treatment initiation.

District hospitals as centres for higher acuity care

While district hospitals continued with routine NCD care, there was gradual transition to focus on complex cases requiring specialist attention. They also provided mentorship to CHC personnel and quality control. This helped to optimize utilization of limited specialist resources.

Digital integration through SPICE

The SPICE digital platform helped to unify the previously fragmented system through:

- Offline-first functionality ensuring continuity of care despite intermittent connectivity
- Unified patient records accessible across all care levels
- Real-time coordination between CHWs, CHCs, and hospitals
- Embedded clinical protocols, standardizing care quality

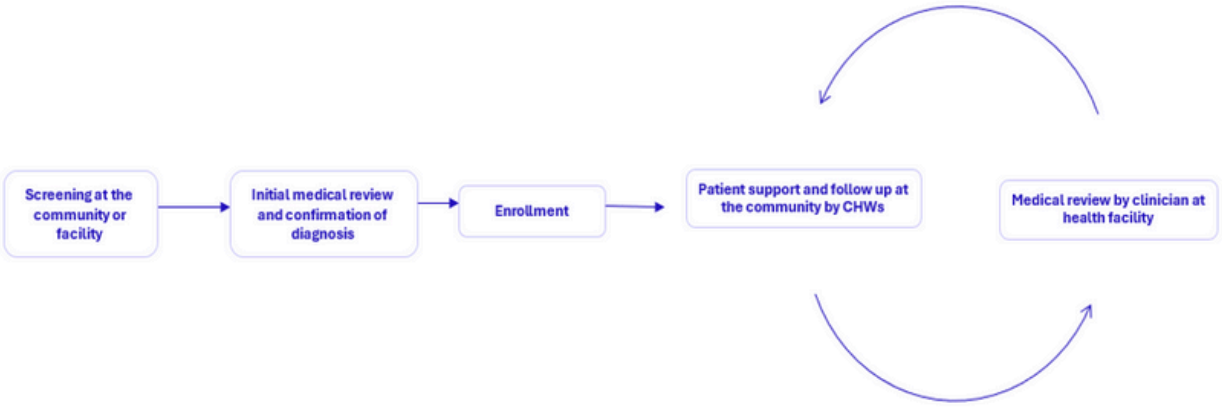


Figure 2: Patient journey from screening to management

KEY FINDINGS: UNPACKING THE PROGRAM DATA

Screening and disease burden

As at end of January 2025, the program supported the screening of 25,320 individuals for hypertension, with 17,829 (70%) of them being also screened for diabetes across the four districts. The screened population demonstrated a notable female majority (63%), likely reflecting barriers that limit male engagement with CHW services, including work schedules that limit daytime availability for door-to-door screening. Those aged 40 years and above made up 52% of the population screened.

The program identified elevated blood pressure in 9,876 (39%) of those screened. This figure aligns closely with 2023 WHO estimates of 41%[10] and the 2009 STEPwise survey findings (37% males & 33% female),[13] though it exceeds the 22% reported in some local surveys.[14] The finding that 1,233 (13%) had critical BP values requiring immediate medical attention (BP ≥ 180/110 mmHg)[15] underscores the life-saving potential of community-based screening outreach.

Among those screened for diabetes, 13% had elevated BG levels in the diabetes range (FBG ≥7 or RBG ≥11.1mmol/L), while 19% had prediabetes/impaired glucose tolerance range readings (FBG 6.1-6.9/RBG 7.8-11mmol/L). Notably, among those with diabetes range readings (n=2,316) 88 (4%) individuals had critical levels (FBG or RBG > 18 mmol/L)[12] requiring urgent intervention. The 13% diabetes range elevated BG rates significantly exceed International Diabetes Federation (IDF) country estimates (4.8%),[11] and 6.2%[16] and 2.2%[17] reported from local studies, likely reflecting the program's targeted screening approach that prioritized high-risk individuals.

Linkage to care and enrollment

Among those with elevated readings, 8,776 (71%) were ultimately diagnosed and enrolled into long-term care, with slightly higher referral completion rates among females (73%) than males (69%), a pattern consistent with documented gender disparities in health-seeking behaviors.[18] The 71% completion rate represents substantial improvement over previously reported cascades, where fewer individuals typically complete the screening-to-treatment pathway.[14,19]

Of those enrolled from screening, 7,212 and 4,265 were diagnosed with hypertension and diabetes, respectively. The program enrolled an additional 1,945 patients with hypertension, and 967 with diabetes who had an existing diagnosis during their routine clinic visits, cumulatively enrolling 11,253 patients into the program. These figures demonstrate the value of community-based screening in expanding access to care, as more than 75% of the patients were enrolled through community-based screening outreach (*Figure 3*).

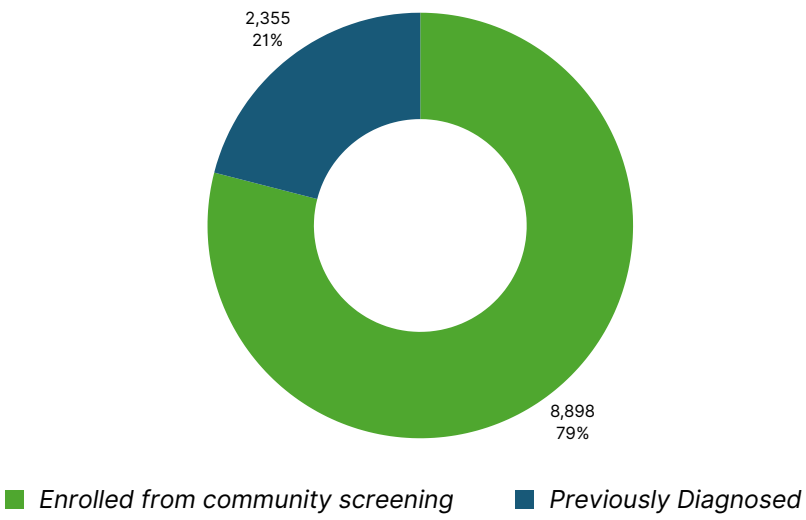


Figure 3 Patient enrollment pathways

Among those enrolled, 6,021 (53%) had hypertension, 2,096 (19%) had diabetes, and 3,136 (28%) with both diabetes and hypertension. The finding that close to a third of enrolled patients had both hypertension and diabetes underscores the importance of integrated NCD care rather than vertical disease-specific programs that fragment patient experience and multiply access barriers.

The majority (66%) of those enrolled in the program were female, 48% were overweight/obese, and 73% above 40 years. The Bombali district had the highest number of those enrolled (41%), followed by Western Area Rural (28%), Western Area Urban (21%), and Port Loko (10%).

Longitudinal follow-up

Longitudinal follow-up data revealed the sobering reality of maintaining engagement in chronic disease care. Among patients with hypertension enrolled for ≥12months, 56% had documented BP assessment at six (±2) months, reducing to 35% at twelve (±2) months, with only 23% sustaining follow-up at both timepoints. Patients with diabetes patients showed slightly better but still suboptimal patterns, with 57% having a documented BG at six months, 42% at twelve months, and 29% at both timepoints. Figure 4 shows follow-up rates for hypertension and diabetes patients at six- and twelve months post-enrolment.

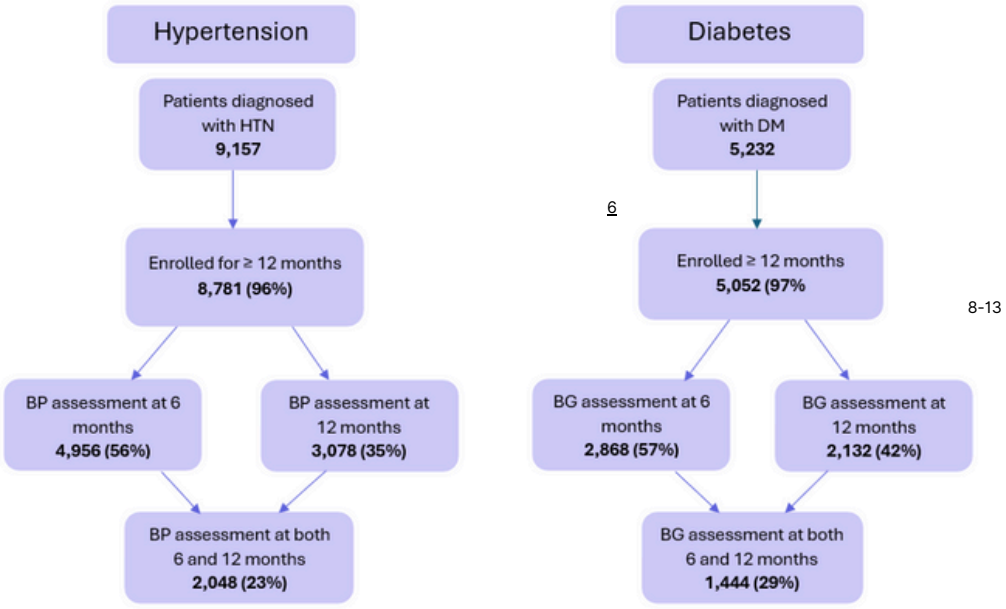
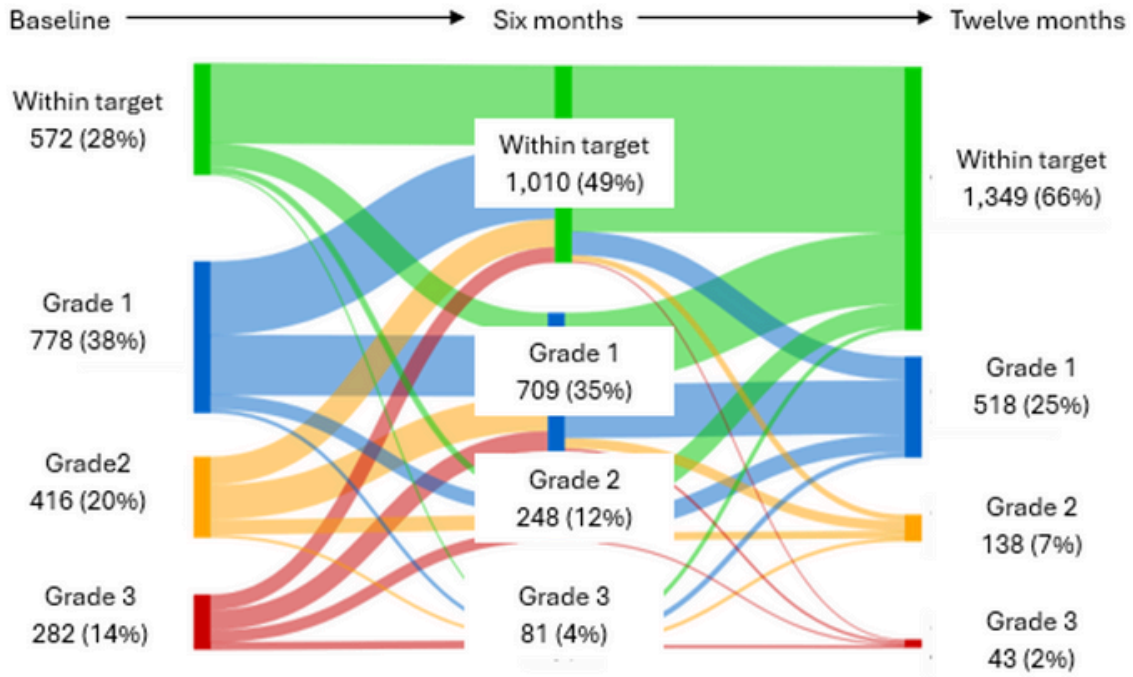


Figure 4 Patient follow-up rates at 6 and 12 months

Cohort outcomes at six and twelve months

Among patients with hypertension with documented baseline, six- and twelve-months BP data, control rates increased from 28% at baseline, to 49% at six months and further to 66% at twelve months. The sub-cohort of patients enrolled with elevated blood pressure levels (BP≥140/90mmHg) at enrolment experienced significant improvement, with 41% achieving control at six months and 61% at 12 months, with 73% of them achieved a clinically significant reduction in systolic BP (≥ 10 mmHg).[20] The number of patients with severe (grade 3) hypertension reduced by 85%, grade 2 by 67%, and grade 1 by 33% (Figure 5). Mean systolic BP significantly reduced by 14.7 mmHg from 147.1 mmHg to 132.4 mmHg (p <0.001) while mean diastolic BP reduced by 8.3 mmHg from 91.5 mmHg to 83.2 mmHg (p<0.001) over the 12 months.



Within target: SBP <140 mmHg and DBP < 90 mmHg: **Grade 1**: SBP (140-159) mmHg and/or DBP (90-99) mmHg: **Grade 2**: SBP (160-179) mmHg and/or DBP (100-109) mmHg: **Grade 3**: SBP ≥ 180 mmHg and/or DBP ≥ 110 mmHg.

Figure 5 Shifts in hypertension severity
Grading of hypertension adopted from the European Society of Hypertension 2023 Guidelines[15]

The proportion of patients with diabetes achieving control (HBA1C <7%/FBG <7mmol/L/RBG ≤9mmol/L[12]) nearly tripled from 25% to 71% (Figure 6) and 48% of those enrolled with uncontrolled BG levels achieving control at twelve months.

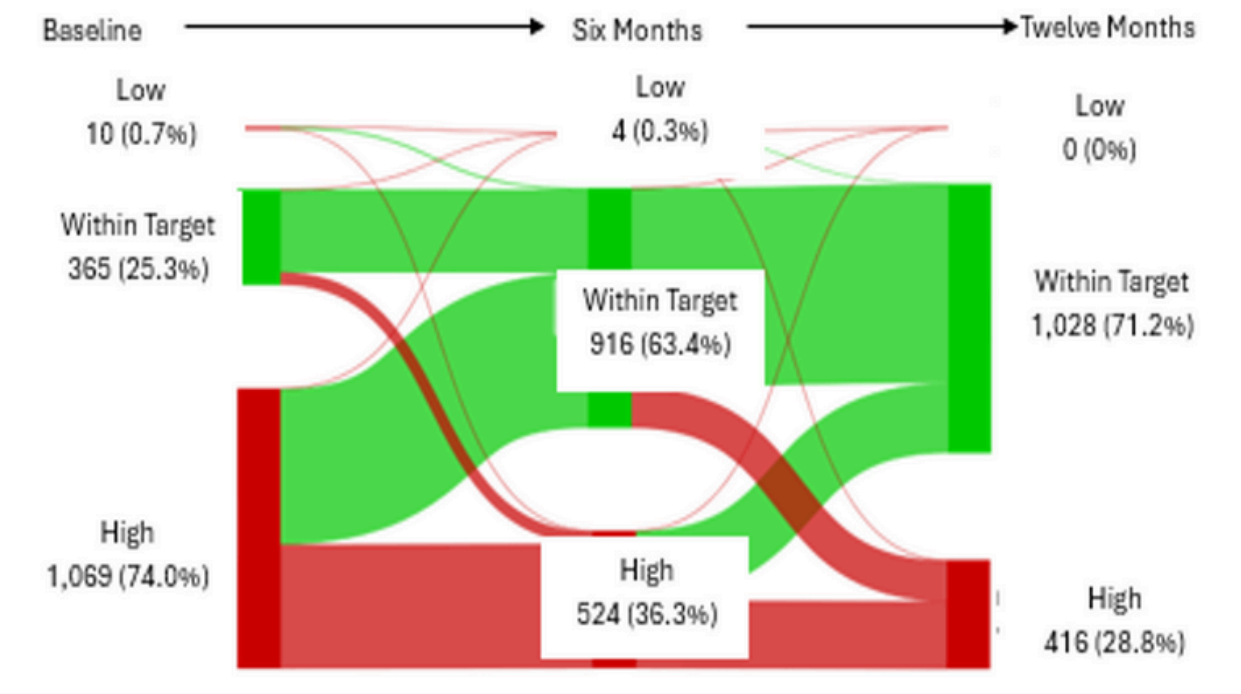


Figure 6 Changes in glycemic levels

Discussion and Implications

The Bette Lyfe program contributes to evidence on the role of digital in real time monitoring and improving NCD care delivery in low-resource settings. The program's reach of over 25,000 screened and 11,000 enrolled, with majority (79%) being enrolled from community-based screening outreach, represents substantial expansion of NCD services beyond traditional passive facility-based care. The high rates of elevated BP (39%) and BG (13%) provides additional, real-world evidence of the NCD burden in Sierra Leone. The high screening referral-to-enrolment linkage rate, compared to typical cascades where the majority are lost between screening and treatment initiation,[14,19] shows that barriers to initial engagement can be overcome through thoughtful program design. The same-day clinical evaluation, while resource-intensive and logistically complex, proved essential by eliminating the delays that allow doubt, competing priorities, and other practical barriers to prevent care-seeking. This comprehensive outreach approach, though not entirely new in concept, represented a critical adaptation to Sierra Leone's context.

The program design strengthened several aspects in Sierra Leone's health system. By leveraging CHWs for hypertension and diabetes screening and follow-up, in a country where CHWs do not routinely conduct these services, Bette Lyfe extended reach beyond facility-based care, given the barriers to healthcare access in Sierra Leone such as transport costs.[21] Integration of digital technology at the community and facility created a unified data system that enabled real-time monitoring of patients across the care continuum, addressing the fragmentation of care that occurs from limited use of data collected by CHWs.[22] While CHWs facilitated community reach, some demographic differences were observed. The female predominance in both screening and enrollment reflects broader patterns of healthcare utilization and highlights the need for targeted strategies to engage men in NCD care, such as workplace screening and care programs.

Despite high linkage-to-care rates, there was progressive attrition over time, with less than a third of enrolled patients having a documented assessment at six and twelve months for both hypertension and diabetes. However, the program was implemented in only 17 of the 357 health facilities in the four districts,[23] and the reduced retention rates could reflect patients seeking care at non-program facilities that were not digitally equipped. Nevertheless, these rates are consistent with global trends where initial enthusiasm for treatment among those diagnosed gradually diminishes due to the asymptomatic nature of disease and inaccurate perception of treatment efficacy.[24] A study conducted in Sierra Leone to investigate retention in NCD care identified long wait times, transport costs and misunderstanding of the need for life-long care as major barriers, while facilitators included high quality patient education, free medications and empathetic provider-patient interactions.[21] Given that retention is a major barrier to chronic disease care, implementing some of these recommendations and systematically studying their effects is a critical next step. For instance, institutionalizing the decentralization and task-shifting/sharing approach across the country might improve access to care, reduce waiting time and reduce transport costs. It is estimated that only 36% of CHCs offer hypertension diagnosis and management services in the country. Worse still is that only 17% of Government-owned and 15% of rural health facilities offer these services, severely curtailing access and continuity of care. The situation is worse for diabetes, where only 25% of CHCs, 9% of Government and 7% of rural facilities can offer these services.[25]

Consistent availability of affordable medications at CHCs might motivate patients to remain engaged. The mean availability of essential hypertension and diabetes medications (amlodipine or other calcium channel blocker, enalapril or other ACE inhibitor, metformin, glibenclamide) is <10%.[25] This means that even when patients overcome other barriers to reach facilities, frequently encountering medication stock-outs renders their sacrifice futile and discourages future attempts to sustain

engagement in care. End-to-end digital networks across all facilities in entire districts, or even the whole country, across both public and non-public facilities might provide the visibility of patient care continuum, rather than digitizing just a fraction of facilities and CHWs.

The outcomes observed rival those reported from high-income countries and dramatically exceed typical results from African healthcare settings,[26] demonstrating that quality care is achievable when patients remain engaged.

Pathways to sustainable scale

The Bette Lyfe experience demonstrates that quality chronic disease care in Sierra Leone is feasible, but institutionalizing and scaling the model requires rethinking of financing, implementation, and health system organization. The model's findings identify high-impact interventions deserving priority investment. However, rather than perpetual donor dependence or abandoning proven interventions as unsustainable, several pathways offer realistic pathways to scale while acknowledging resource constraints.

Phased integration into existing systems represents the most pragmatic approach to sustainability. Sierra Leone's CHW program already includes some NCD components, providing a foundation for enhancement. The Ministry of Health should prioritize expanding the existing CHW scope to move beyond symptom inquiry to biometric measurements. The first phase would equip CHWs in high-burden districts with basic BP monitors, glucometers and digital devices, leveraging existing supervision and compensation structures while adding measurement capabilities. This targeted approach would require minimal additional investment while significantly enhancing NCD screening and early detection capacity. Subsequent phases could expand coverage as systems mature and move beyond screening to community-based follow-up monitoring.

Alternative financing mechanisms would move beyond traditional health budgets to generate resources for NCD care. Implementation and ringfencing of taxes on tobacco and sugar-sweetened beverages, already proposed in the national NCD strategy,[5] could generate dedicated funding while simultaneously reducing the disease burden. Evidence from South Africa and Mexico demonstrates that such taxes can generate substantial revenue while achieving public health objectives.[27–29] The economic and efficiency gains from early diagnosis and treatment, preventing costly complications that currently consume massive health resources, would create savings for prevention programs.

Public-private partnerships, such as the Bette Lyfe program, offer models that expand reach while distributing financial burden. Faith-based organizations, which provide approximately a third of healthcare services in Sierra Leone,[30] demonstrated willingness to contribute infrastructure and staff time when provided with training and basic equipment. Expanding this model to include other private sector players, telecommunications companies to subsidize connectivity costs, and employers as workplace screening sponsors could create sustainable ecosystems for NCD care that don't depend solely on government resources.

Conclusion

The Bette Lyfe program shows that combining community outreach, decentralized care, strategic task-sharing/shifting and digital technology can improve detection, linkage, and control of hypertension and diabetes in low-resource settings. In essence, the program found disease, linked people to care, struggled with retention, but achieved good outcomes for those who were followed up. Institutionalization and scale of this model is feasible, but requires acknowledging and addressing the continuity of care realities identified, policy and practice reforms, and alternative blended financing mechanisms to sustain its population impact.

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