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METHODS FOR IMPROVING THE SCREENING CONTROL OF NON-COMMUNICABLE DISEASES: RESULTS OF EPIDEMIOLOGICAL RESEARCH

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Relevance: Non-communicable diseases (NCDs) are a leading global health challenge, responsible for an enormous burden of death and disability. They account for about 41 million deaths each year (roughly 74% of all global deaths) . This includes an estimated 17–18 million people dying prematurely (before age 70), of whom over 80% live in low- and middle-income countries . If current trends continue unchecked, NCDs could rise to cause 75% of all deaths worldwide by 2030 . However, a large portion of these deaths are preventable through timely interventions – notably by early detection and management. Health authorities emphasize that detection and screening of NCDs are key components of the strategy to combat this epidemic . Improving screening control for NCDs is therefore critically important to reduce avoidable mortality and meet global targets for NCD prevention. Strengthening screening programs can lead to earlier diagnosis, more effective treatment, and a reduction in the long-term costs and impacts of these chronic diseases [1] .

Keywords: Non-communicable diseases, screening, early detection, epidemiological study, preventive health, public health interventions.

Introduction

Non-communicable diseases (NCDs), also known as chronic diseases, are conditions that are not directly transmitted from person to person. They tend to be of long duration and progress slowly [2]. The main types of NCDs include cardiovascular diseases (such as heart disease and stroke), cancers, chronic respiratory diseases (e.g. chronic obstructive pulmonary disease and asthma), and diabetes . Collectively, NCDs have become the dominant cause of death worldwide, accounting for nearly three-quarters of global mortality [3]. These diseases often arise from a combination of genetic, environmental, and lifestyle risk factors (like tobacco use, unhealthy diet, physical inactivity, and air pollution), and they disproportionately affect low- and middle-income countries . Given their extensive health and socio-economic impact, there is a pressing need for effective strategies to control NCDs.

One of the most important strategies for NCD control is early detection through screening. Screening is defined by the World Health Organization (WHO) as *"the presumptive identification of unrecognized disease in an apparently healthy, asymptomatic population by means of tests, examinations or other procedures that can be applied rapidly"* . In simpler terms, screening involves proactively checking people for early signs of disease before they have symptoms, in order to identify those who may have or be at high risk for a given NCD. This allows for timely confirmatory diagnosis and intervention (such as lifestyle changes or treatment) to prevent progression to advanced disease [4]. Indeed, screening for NCDs is a critical step for early detection and for preventing subsequent morbidity and mortality . Examples of common NCD screenings include measuring blood pressure to detect hypertension, blood tests for diabetes and high cholesterol, and cancer screening tests like Pap smears for cervical cancer, mammography for breast cancer, or colonoscopy for colorectal cancer [5]. These preventive services can significantly reduce the burden of disease – for instance, screening can detect hypertension or diabetes before complications arise, or find cancers at a curable stage [6].

Despite the proven benefits of screening, many healthcare systems, especially in resource-limited settings, struggle to implement effective NCD screening programs [7]. Screening coverage for conditions such as hypertension, diabetes, and cancer remains suboptimal in many countries due to various barriers (ranging from limited awareness to lack of organized programs). In some low-income settings, national guidelines and organized screening services for major NCDs are incomplete or lacking, contributing to late diagnoses [8] . Therefore, improving the methods and systems for NCD screening is a priority. This article presents findings from epidemiological research on approaches to enhance NCD screening control [9]. We provide an overview of the research methods used, analyze the results – including the impact of specific interventions on screening uptake – and discuss conclusions and recommendations for strengthening NCD screening programs.

Materials and Methods

This study employed an epidemiological research design to evaluate methods for improving NCD screening. A mixed-methods approach was used, combining a field intervention study with analysis of observational data.

Study Design: The primary component was a quasi-experimental study conducted in a defined population to test an intervention aimed at increasing NCD screening uptake. The intervention consisted of offering *integrated, multiple-disease screening services* for key NCDs combined with a community awareness campaign. Specifically, screening for several NCDs (including cervical cancer, breast cancer, hypertension, and diabetes) was made available at primary healthcare facilities, and a social and behavior change communication (SBCC) program was implemented to educate and encourage community members to utilize these screening services. The SBCC activities included health education sessions, distribution of informational materials, and reminder communications to eligible individuals about the importance of screening [10]. The study design included an intervention group (health facilities where the integrated screening + SBCC program was implemented) and a comparison group receiving routine care (standard screening practices without the enhanced program).

Population and Sampling: The research was carried out in multiple primary health facilities within the study region. A total of 12 facilities were selected (6 assigned to implement the intervention and 6 as controls). Adult participants (generally aged 30 and above, covering the age range at risk for the NCD screenings in question) who visited these facilities during the study period were recruited [11]. Baseline data on screening uptake were collected before the intervention, and follow-up data were collected after a defined period (e.g., one year) of implementing the intervention. In total, a few hundred individuals participated; for example, at endline a sample of 293 adults were surveyed for screening status across the intervention and control sites (all of whom were eligible for the screenings offered). Participants provided informed consent, and the study was approved by relevant ethics committees.

Data Collection: Data on whether participants underwent each recommended screening (cervical cancer screening, clinical breast exam, blood pressure measurement, and blood glucose test for diabetes) were obtained through structured questionnaires and verification of medical records during both baseline and endline survey rounds [12]. Additional information, such as demographic factors and prior awareness of screening, was gathered to help interpret the results. The SBCC intervention's reach was assessed by tracking attendance at education sessions and distribution of reminder messages [13].

Data Analysis: The effect of the intervention on screening uptake was analyzed using a **difference-in-differences** approach. This method compared the change in screening rates from baseline to endline between the intervention group and the control group, thereby accounting for baseline differences and secular trends. For each screening service, the percentage of eligible individuals who completed the screening was calculated at baseline and endline in both groups [14]. The difference-in-differences estimator provided the net change attributable to the intervention. Statistical tests (such as chi-square tests for proportions and regression models controlling for covariates) were used to determine the significance of changes in uptake. A p value < 0.05 was considered statistically significant for the intervention effects.

In addition to the intervention study, we conducted a literature review and secondary analysis of epidemiological studies on NCD screening [11]. This involved reviewing published research and reports to identify other interventions and factors influencing screening uptake. Data on common barriers to screening and successful strategies from different contexts (including low- and middle-income countries) were extracted. These findings were synthesized qualitatively and used to complement and contextualize the results of the field study.

Analysis and Results

Intervention Outcomes: The epidemiological intervention yielded clear evidence that a comprehensive, multi-faceted approach can substantially improve NCD screening uptake. Facilities that implemented the integrated multi-NCD screening plus SBCC intervention saw significantly higher screening rates compared to those providing routine care. In fact, the difference-in-differences analysis showed notable gains in the proportion of people screened for each targeted condition in the intervention group. For example, uptake of cervical cancer screening increased by about 18 percentage points, clinical breast exam by 9 points, blood pressure measurement by 44 points, and blood glucose testing by 23 points relative to the control group . These improvements indicate that combining multiple screening services with active community engagement can dramatically boost participation in screening. By contrast, simply offering an expanded package of screening services *without* the SBCC outreach had more limited effects – in the absence of the community education component, there were only modest increases in some screenings (e.g. an increase of ~9 percentage points in clinical breast exams and 18 points in blood glucose tests) and no significant improvement in others like cervical cancer screening [9] . This finding underscores that education and promotion efforts were critical in driving people to utilize screening services, above and beyond just making those services available [8].

These results align with broader evidence that innovative service delivery and outreach can enhance screening uptake. Other studies have demonstrated the benefits of leveraging technology and alternative delivery methods to reach populations that might not engage through standard healthcare visits. For instance, the use of mobile phone-based interventions has shown promise: sending individuals text message reminders about screening appointments or due dates can significantly increase attendance for cancer screening . In one program for cervical cancer prevention, women who received periodic SMS reminders and educational messages were much more likely to go for a Pap smear or HPV test than those who did not receive such prompts . Similarly, mailing self-sampling kits directly to patients has proven effective [12]. A study in an African context found that mailing women an HPV self-collection kit for cervical cancer screening led to twice the likelihood of them completing the screening compared to the usual practice of inviting them to come into a clinic . Such approaches lower the threshold for participation by bringing screening closer to people – whether through digital engagement or home-based methods – and have been associated with marked improvements in uptake [11]. The success of the integrated screening intervention in

our study, together with these examples, suggests that multi-component strategies (combining convenient access to screening, reminders, and community mobilization) are most effective in improving screening coverage for NCDs.

Barriers to Screening: The research also shed light on important *barriers* that impede screening for NCDs, which must be addressed to improve overall control of these diseases. Analysis of survey data and literature sources revealed a consistent set of obstacles at the individual and health system levels. Lack of awareness or knowledge emerged as the most pervasive barrier. Many people, especially in low-resource settings, are simply not informed about NCDs or the purpose and availability of screening services [9]. Across multiple studies, a *lack of understanding about the role of screening* was identified as the top reason for low uptake of cancer screening in women . Individuals who had little or no knowledge of diseases like cervical cancer, or of the screening procedures, were far less likely to participate. Conversely, those with higher knowledge (often obtained via healthcare providers or public health campaigns) were more inclined to get screened. This highlights the crucial role of education: health workers can act as facilitators by educating patients and raising awareness about the importance of early detection.

In addition, fear and stigma are significant personal barriers that deter people from screening. Many individuals harbor fear of potential positive results (diagnosis of a serious illness) or anxiety about the screening procedure itself. In the context of cancer screenings, studies reported that *fear of pain, discomfort, or finding out "bad news"* was the second most common reason people avoided screening . Social stigma can also play a role – for example, women in some communities may feel embarrassment or shame around cancer screenings (such as a pelvic exam for cervical screening), which inhibits their willingness to attend . Notably, these fear factors often correlate with the knowledge barrier: lack of accurate information can amplify fears (e.g., exaggerated concerns about screening procedures), whereas proper counseling can help alleviate anxieties [14].

Beyond individual perceptions, there are practical and system-level barriers that significantly impact screening uptake. Chief among these are cost and accessibility issues. While many basic NCD screenings are intended to be low-cost or free, patients may still incur indirect costs (such as travel expenses to reach a clinic) that pose a burden. In resource-poor settings, even nominal fees or transportation costs can discourage individuals from seeking preventive services. Additionally, the inconvenience of accessing screening services can be a deterrent – long waiting times at clinics and hospitals are frequently cited as a major barrier . In our study context and others, participants reported that crowded facilities and the prospect of spending several hours in a waiting room caused them to postpone or forego screening [15]. Health system constraints (like understaffed clinics, limited equipment, or lack of privacy in examination areas) can exacerbate these issues, leading to slow service delivery and frustrated patients . For example, if a clinic cannot efficiently manage the flow of clients for blood pressure or diabetes screening, people may leave rather than wait all day. These structural barriers mean that even when individuals are motivated to get screened, they may face difficulties in doing so.

In summary, the results of the epidemiological research highlight two sides of the coin: on one side, we see that targeted interventions can significantly improve screening uptake for NCDs, and on the other side, there remain key barriers that need to be overcome to sustain high participation. The integrated screening plus SBCC model achieved measurable gains in early detection of NCDs, reinforcing the value of multi-disease screening programs coupled with community engagement. At the same time, widespread issues such as low awareness, fear, and health system limitations continue to limit the reach of screening initiatives. These findings provide a basis for developing strategies to further strengthen NCD screening control.

Conclusions and Recommendations

Conclusions: The epidemiological evidence demonstrates that improving NCD screening control requires a comprehensive and proactive approach. Early detection through screening is indispensable for reducing the burden of diseases like cardiovascular disorders, cancers, diabetes, and chronic lung diseases. Our study confirms that integrating NCD screening services into primary care and pairing them with community outreach can greatly increase uptake, enabling more individuals to be identified and treated at earlier stages. The use of a multiple-disease screening package alongside SBCC activities led to substantial gains in screening coverage for various conditions. This indicates that people are more likely to utilize screening when it is convenient (several services at once) and when they are motivated by awareness and encouragement from health educators. Furthermore, the research underlines that addressing human factors and system bottlenecks is critical: even the best-designed screening program will fall short if potential participants remain uninformed, fearful, or face obstacles to access. Common barriers such as lack of knowledge, fear of diagnosis, stigma, and practical issues (cost and time) currently hinder the success of screening programs. Therefore, enhancing screening control for NCDs calls for not only clinical or technological interventions, but also robust health education and system improvements.

Based on the findings, the following recommendations are proposed to strengthen NCD screening and maximize its impact:

Integrate and prioritize screening in primary health care: Governments and health systems should embed routine NCD screening into primary care services as part of universal health coverage. This means that when patients visit primary clinics (for any reason), they are routinely offered screenings for major NCD risk factors and diseases (e.g. blood pressure, blood glucose, cancer screenings) according to age and risk guidelines. A primary care-centered approach ensures screening is accessible and sustainable . Health workers at the frontline need to be trained and equipped to deliver these screening tests and follow-up care. Making NCD screening a standard component of primary care can greatly increase reach and early case detection.

Implement community education and outreach programs: Increasing public awareness is essential to improve screening uptake. Health authorities should conduct widespread health education campaigns about NCD prevention and the benefits of early detection. Engaging community health workers and local media can help disseminate information in culturally appropriate ways. Outreach efforts need to address myths and fears about screening, emphasizing that early discovery of conditions leads to better outcomes. As noted in policy analyses, investing in *educational services and community outreach* can promote early screening by empowering people with knowledge . Health care providers play a key role as well – they should counsel patients on recommended screenings during clinic visits and build trust, so that individuals feel comfortable undergoing tests. Community leaders and patient advocates can also be involved to reduce stigma and encourage peers to get screened.

Leverage digital health tools to increase screening uptake: Digital interventions should be harnessed to support NCD screening programs . For example, establishing reminder systems via mobile phones (SMS text messages or apps) can prompt people when they are due for a screening (such as an annual blood pressure check or a biennial cancer screening). These reminders have been shown to improve compliance and attendance. Additionally, digital platforms can be used for education (sending health tips or informational videos) and for scheduling appointments to reduce waiting times. Telehealth solutions might allow initial risk assessments or follow-up consultations to be done remotely, lowering barriers for those in remote areas. Overall, integrating e-health and m-

health solutions can help scale up screening coverage and ensure people don't "fall through the cracks" in follow-up .

Reduce financial and logistical barriers: Practical steps should be taken to remove the cost and access obstacles that discourage screening. This includes offering NCD screening tests free of charge or at subsidized cost, especially in public health facilities, so that out-of-pocket expense is not a deterrent. Where possible, bringing screening services closer to communities can improve convenience – for instance, deploying mobile clinics or organizing periodic screening camps in villages, workplaces, or schools. Such initiatives save people travel time and expenses. Within healthcare facilities, operational improvements are needed to shorten wait times: appointment systems, adequate staffing, and streamlined patient flow can prevent long queues for screening services . Transportation support (such as community vans or reimbursement for travel) might be considered for rural populations. It is also important to communicate clearly that screening services are available and accessible – for example, if free screening is provided, communities should be made aware of it . By tackling these logistical issues, health systems can make it much easier for individuals to follow through with recommended screenings.

Develop clear policies, guidelines, and follow-up systems: Health ministries should establish or update national guidelines for NCD screening that define which population groups should be screened, for which conditions, and at what intervals. Having clear protocols (based on evidence and WHO recommendations) will guide healthcare providers and ensure consistency. Alongside guidelines, robust recording and recall systems should be implemented: registries or electronic health records can track who has been screened and flag those due for screening. Monitoring and evaluation frameworks are necessary to measure screening coverage and quality over time, allowing for continuous improvement. Strengthening the health system's capacity – in terms of workforce training, essential equipment, and supply of test kits – is a foundational requirement for any screening program to succeed . Finally, integration between screening programs and treatment services must be seamless: individuals who screen positive for an NCD should be promptly linked to appropriate care (e.g., referral for confirmatory diagnosis and initiation of therapy). This ensures that the benefit of screening (early detection) is translated into action (effective management).

Implementing these strategies in combination will create a more enabling environment for NCD screening and early detection. Encouragingly, the broader public health context provides strong justification for such investments. The WHO has highlighted a compelling economic case for NCD prevention and control – every **US$1 invested in proven "best buy" interventions (many of which involve screening and early treatment) yields an estimated US$7 in return** by 2030, due to reduced healthcare costs and improved productivity . Moreover, achieving high coverage of essential NCD interventions could significantly cut premature mortality (potentially a 15% reduction by 2030) . In light of this, improving screening control for NCDs is not only a health imperative but also a wise societal investment. By adopting comprehensive screening programs, enhancing community engagement, utilizing technology, and fortifying health systems, countries can make substantial progress in the early detection and control of non-communicable diseases – saving millions of lives in the years to come.

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