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Community-Based Hearing Screening for Healthy Aging

Dr. Amr El Refaie

Senior Lecturer, University College Cork, Ireland

Abstract

Age-related hearing impairment is an important but frequently under-recognized component of healthy aging because progressive auditory decline can interfere with communication, social participation, functional independence, emotional well-being, and access to health information. Community-based hearing screening offers an opportunity to identify possible hearing impairment before substantial communication disability develops, particularly among older adults who rarely seek specialist audiological care. The present study develops a simulation-based framework for evaluating a community hearing-screening pathway that combines brief self-report assessment, portable or smartphone-supported hearing screening, referral triage, diagnostic follow-up, and linkage to appropriate hearing rehabilitation. A hypothetical cohort of 500 community-dwelling adults aged 60 years or older was modeled to compare a structured community-based screening pathway with an opportunistic usual-care pathway. Because no original participant dataset was supplied, all numerical findings are explicitly synthetic and are intended for methodological demonstration rather than clinical inference.

The modeled community pathway achieved higher screening participation, diagnostic follow-up, and initiation of hearing care. Screening participation reached 86% in the community pathway compared with 61% in the opportunistic pathway, while simulated care initiation reached 24% and 12%, respectively. The analysis further demonstrates that successful screening programs should be evaluated not merely by the number of tests performed but by their capacity to move screen-positive older adults toward diagnostic confirmation, counseling, rehabilitation, assistive technology, or specialist treatment where required. Earlier research supports the feasibility of several brief hearing-screening approaches and identifies hearing impairment as relevant to psychosocial and cognitive dimensions of later life. The study concludes that community hearing screening can be positioned as an accessible entry point within healthy-aging services, provided that positive screens are linked to reliable diagnostic and rehabilitative pathways.

Keywords: hearing screening; healthy aging; older adults; community health; age-related hearing loss; audiology; hearing-care access; preventive health

1. Introduction

Population aging has increased the importance of maintaining functional ability rather than considering healthy aging solely in terms of survival or absence of disease. Hearing capacity is particularly relevant because auditory communication supports interpersonal interaction, participation in family and

community life, access to health information, and independent navigation of everyday environments. Hearing loss is common in later life, yet many affected adults gradually adapt their behavior to communication difficulty and may not seek formal assessment until impairment has become functionally significant. The World Health Organization has incorporated hearing capacity within its integrated-care approach for older people, recognizing hearing impairment as a relevant decline in intrinsic capacity that may require community-level identification and management.

The consequences of hearing impairment extend beyond reduced audibility. Difficulty understanding conversation can increase listening effort and may lead an older person to withdraw from group interaction, avoid community activities, or depend increasingly on family members for communication. Shukla and colleagues' 2020 systematic review found that most multivariable studies included in their review reported associations between hearing loss and greater loneliness or social isolation among older adults. Lawrence and colleagues likewise reported a statistically significant association between hearing loss and depression in later life. These associations do not establish that hearing screening alone will prevent psychosocial decline, but they strengthen the argument that auditory health deserves attention within multidimensional healthy-aging strategies.

Hearing impairment has also received growing attention in cognitive-aging research. Amieva and colleagues reported that self-reported hearing loss was associated with accelerated cognitive decline in their long-term observational study, while the 2020 Lancet Commission included hearing loss among potentially modifiable factors considered in dementia-prevention frameworks. The evidence available through 2020 did not justify assuming that every hearing intervention prevents dementia, and later-life cognitive outcomes are influenced by numerous interacting determinants. Nevertheless, the accumulated literature establishes hearing function as relevant to broader aging trajectories and provides a strong rationale for timely identification rather than passive recognition after severe disability develops.

Traditional audiological assessment depends on trained professionals, calibrated equipment, appropriate testing environments, and referral access. These conditions are essential for diagnosis but may restrict population reach when they are treated as prerequisites for every initial hearing check. Research has therefore examined brief self-report tools, handheld screening devices, smartphone-based approaches, and digits-in-noise testing. Yueh and colleagues demonstrated that several screening strategies could identify older adults who might require further assessment, while Potgieter and colleagues reported strong diagnostic discrimination for a smartphone digits-in-noise approach when language competence and age were appropriately considered. These approaches are most appropriately viewed as gateways to professional evaluation rather than substitutes for diagnostic audiometry.

The present study therefore examines community-based hearing screening for healthy aging as a complete service pathway rather than an isolated screening event. The central premise is that the value of screening depends on whether older adults can move from community identification to diagnostic clarification and appropriate care. A simulation-based comparative model is used because no empirical participant dataset was provided. The study consequently avoids presenting synthetic values as real-world clinical findings and instead develops a transparent analytical framework that can guide a subsequent community trial, implementation study, or population-based evaluation.

2. Objectives of the Study

2.1 To Evaluate the Reach of Community-Based Hearing Screening

The first objective is to examine whether embedding hearing screening within accessible community settings could theoretically increase the proportion of older adults receiving an initial hearing assessment compared with a predominantly opportunistic model in which screening occurs only when individuals independently seek clinical care. Community settings may include primary-care outreach programs, senior centers, healthy-aging camps, community clinics, mobile health services, and other locally accessible preventive-health environments.

Reach is conceptualized more broadly than attendance. An effective program must provide a screening method that older adults can understand, tolerate, and complete without unnecessary technical burden. Screening procedures should therefore be brief, culturally appropriate, sensitive to literacy and language, and capable of identifying participants who require further professional evaluation. The objective is not to maximize positive-screen numbers, but to reduce avoidable under-identification while maintaining an interpretable referral threshold.

2.2 To Examine Continuity From Screening to Hearing Care

The second objective is to assess the hypothetical continuity of participants from initial screening through diagnostic follow-up and eventual care initiation. Screening programs can generate little public-health value when individuals who screen positive cannot access subsequent audiological assessment. For this reason, the present model defines successful screening as the beginning of a hearing-care pathway rather than the end of a community event.

Continuity indicators include screening completion, identification of a possible hearing deficit, referral acceptance, attendance for diagnostic evaluation, and initiation of an appropriate management strategy. Management may include counseling, communication strategies, removal of treatable obstruction where clinically indicated, hearing-device evaluation, auditory rehabilitation, or referral to otolaryngology for conditions outside the scope of routine rehabilitation.

2.3 To Position Hearing Screening Within Healthy-Aging Practice

The third objective is to determine how hearing screening can be conceptually integrated with broader healthy-aging services. Hearing capacity influences how older adults communicate with health professionals, understand health advice, maintain relationships, and participate in daily activities. A hearing-care pathway should therefore interact with primary care, geriatric assessment, mental-health support, cognitive assessment where clinically indicated, and social-participation interventions rather than remaining entirely isolated within specialist audiology.

This objective deliberately avoids treating hearing impairment as a single explanation for complex outcomes such as cognitive decline, depression, or social isolation. Instead, hearing screening is conceptualized as one modifiable access point within multidimensional aging care. Such an approach is consistent with the WHO integrated-care framework, which places sensory capacities within a broader model of maintaining functional ability in older adults.

3. Review of Literature

3.1 Hearing Screening Methods for Older Adults

Yueh and colleagues reviewed evidence concerning screening and management of adult hearing loss in primary care and highlighted the potential role of screening approaches for detecting previously unrecognized impairment. Their work helped establish the distinction between diagnostic audiology and brief case-finding procedures that can identify people who may benefit from comprehensive assessment. In subsequent screening research, Yueh and colleagues compared approaches including an AudioScope and the Hearing Handicap Inventory for the Elderly–Screening Version, demonstrating that different methods can yield substantially different positive-screen proportions.

Technology-enabled screening subsequently expanded this field. Potgieter and colleagues evaluated a smartphone digits-in-noise test among 454 adults and reported high discrimination between normal hearing and hearing loss when age and English-speaking competence were considered. De Sousa and colleagues also described national-scale implementation of a smartphone digits-in-noise hearing self-test in South Africa, demonstrating the potential reach of mobile screening. These studies are particularly relevant to community programs because they suggest that hearing case finding does not always require a conventional sound-treated audiology suite at the initial stage.

Screening accuracy, however, depends on the definition of hearing impairment, test environment, selected frequency range, language characteristics, device calibration, and referral threshold. A positive screening result therefore indicates the need for additional evaluation rather than establishing an etiological or definitive audiological diagnosis. Community health personnel must communicate this distinction clearly to avoid unnecessary anxiety or false reassurance.

3.2 Hearing Health, Social Participation, and Cognitive Aging

The relationship between hearing loss and social functioning provides an important rationale for early identification. Shukla and colleagues reviewed evidence on hearing loss, loneliness, and social isolation and found that most adjusted studies demonstrated a relationship between impaired hearing and greater risk of loneliness or social isolation. Lawrence and colleagues separately reported increased odds of depression among older adults with hearing loss. Hearing difficulty may therefore intersect with psychosocial health through communication barriers, although causal pathways remain complex and bidirectional.

Cognitive-aging literature provides an additional dimension. Amieva and colleagues observed faster cognitive decline among older adults reporting hearing loss, while Maharani and colleagues reported longitudinal findings suggesting that hearing-aid use may be associated with differences in trajectories of cognitive decline. Sarant and colleagues observed improvement in several hearing-related outcomes and stability or improvement in selected cognitive measures following hearing-aid fitting, but the authors themselves emphasized the need for continued investigation.

The 2020 Lancet Commission placed hearing loss within a broader life-course dementia-prevention framework. This designation is relevant to healthy-aging policy, but it should not be translated into an unsupported claim that community screening or hearing-aid fitting automatically prevents dementia. The defensible implication is narrower: hearing capacity deserves systematic

attention because it is associated with important functional and cognitive-aging outcomes and because hearing impairment is potentially amenable to rehabilitative intervention.

3.3 Evidence Gap and Need for Community Pathway Evaluation

A recurring limitation in hearing-screening programs is the difference between detection and effective care linkage. A community event can report a large number of screened individuals while producing little durable benefit if those with abnormal results do not complete diagnostic assessment. The 2020 implementation-effectiveness work reported by Bettger and colleagues is relevant because it compared hearing-screening strategies in primary-care implementation rather than evaluating test accuracy alone. This reflects an important transition from asking whether screening tools work technically to asking whether they work operationally within health services.

Help-seeking also remains a recognized challenge. Older adults may normalize progressive hearing loss, perceive amplification negatively, underestimate functional consequences, face financial constraints, or lack access to audiologists. Consequently, a community-screening strategy must include counseling and navigation rather than only providing a pass/fail result. Successful implementation requires coordination between community workers, primary-care clinicians, audiologists, otolaryngologists, rehabilitation providers, older adults, and family or communication partners where appropriate.

The principal research gap addressed by the present study is therefore pathway-level performance. Rather than focusing exclusively on test sensitivity or prevalence estimates, the simulation asks whether community-based screening can improve retention across successive steps from invitation to care initiation. This approach generates a measurable framework for subsequent empirical research while avoiding unsupported claims that improved screening participation necessarily produces clinical benefit.

4. Research Methodology

4.1 Research Design and Simulated Study Population

A simulation-based comparative health-services design was adopted. The hypothetical study population consisted of 500 community-dwelling adults aged 60 years or older, divided equally between a structured community-based screening pathway and a usual opportunistic hearing-care pathway. The simulation was constructed for methodological illustration because no original participant-level screening data were supplied.

Eligibility in a future empirical version of the study would include community-dwelling adults aged 60 years or older who were capable of providing informed consent or, where ethically appropriate, participating through approved supported-consent procedures. Individuals already receiving active specialist management could be recorded separately to avoid incorrectly classifying established hearing-care users as newly detected cases.

4.2 Screening and Referral Protocol

The proposed community protocol uses a staged screening procedure. Initial case finding would combine a brief hearing-difficulty question or validated self-report screener with a portable objective

hearing assessment. Depending on resources, the objective component could include calibrated screening audiometry or an appropriately validated speech-in-noise procedure. Research available before 2021 supports the feasibility of several such approaches, including smartphone digits-in-noise testing.

Participants screening negative would receive hearing-health education and advice regarding reassessment if communication difficulty develops. Participants screening positive would be referred for diagnostic evaluation rather than labeled as definitively hearing impaired. Urgent otological symptoms or clinically concerning findings would require direct medical referral rather than routine rehabilitation. Screening personnel would therefore be trained not only in test administration but also in explaining screening limitations and referral requirements.

Table 1: Proposed Community Hearing-Screening and Evaluation Framework

Component	Proposed procedure	Primary measure	Follow-up action
Community invitation	Local outreach to adults aged ≥60 years	Participation rate	Appointment or walk-in screening
Self-report assessment	Brief perceived-hearing difficulty assessment	Possible communication limitation	Objective screening
Objective screening	Portable audiometric or validated speech-in-noise screening	Pass/refer classification	Diagnostic referral when indicated
Diagnostic confirmation	Comprehensive audiological assessment	Hearing status and severity	Individualized management plan
Medical triage	Assessment of symptoms requiring medical review	Clinical referral indication	Otolaryngology/medical evaluation
Rehabilitation linkage	Counseling, communication strategy, device or rehabilitation referral	Care initiation	Scheduled follow-up

4.3 Variables, Proposed Questionnaire, and Data Analysis

The primary outcome is pathway retention, defined as the proportion of the initially invited cohort completing successive stages of screening and follow-up. Secondary outcomes include screen-positive rate, diagnostic attendance, referral completion, time to evaluation, participant acceptability, and initiation of an indicated hearing-care intervention. In an empirical study, demographic and contextual variables should include age, sex, education, communication difficulties, socioeconomic indicators, distance to hearing services, device ownership, prior hearing assessment, and major comorbidities.

Five proposed questionnaire items may be used to examine community acceptability: "The hearing-screening procedure was easy to understand"; "The screening location was convenient for me"; "I understood what my screening result meant"; "I clearly understood whether I needed further hearing assessment"; and "I would recommend community hearing screening to another older adult." Each item could be rated on a five-point Likert scale. These items are proposed and unvalidated and should undergo expert review, pilot testing, psychometric assessment, and cultural adaptation before empirical administration.

5. Analysis

5.1 Simulated Screening Reach and Care-Linkage Outcomes

The simulated findings indicate that the principal advantage of community-based screening may occur at the entry and linkage stages rather than through any assumed change in underlying hearing-loss prevalence. Among the hypothetical 250 adults offered structured community screening, 86% complete the screening procedure compared with 61% in the opportunistic pathway. The difference reflects assumptions about accessibility and active outreach and should therefore be interpreted as a testable implementation hypothesis rather than a measured intervention effect.

Approximately 41% of the initial community-screening cohort is modeled as having a positive screen, compared with 29% of the initial opportunistic cohort reaching a positive screening stage. These percentages do not represent epidemiological prevalence. They reflect differences in pathway participation and case finding within the synthetic dataset. The critical analytical finding is the subsequent retention of participants: 32% of the original community cohort completes diagnostic follow-up, compared with 18% of the opportunistic cohort.

Table 2: Simulated Hearing-Care Pathway Outcomes

Outcome indicator	Community-based pathway (n = 250)	Opportunistic pathway (n = 250)	Simulated difference
Initial cohort invited/eligible	100%	100%	—
Screening completed	86%	61%	+25 percentage points
Positive screening stage reached	41%	29%	+12 points
Diagnostic follow-up completed	32%	18%	+14 points
Appropriate hearing care initiated	24%	12%	+12 points
Understood referral recommendation	82%	64%	+18 points

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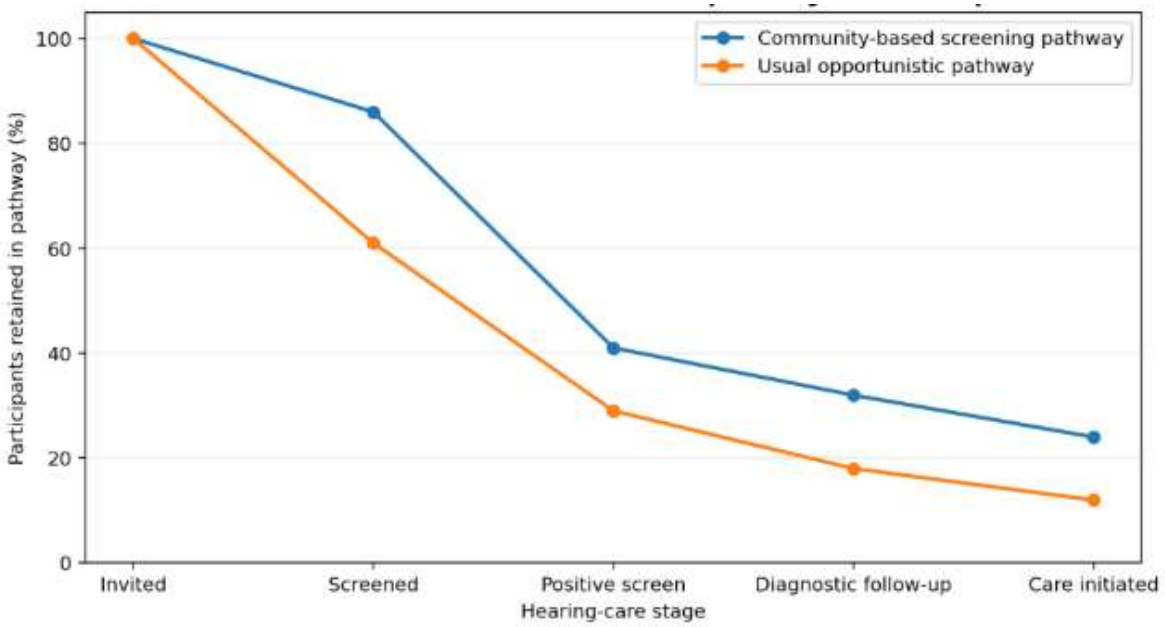
Note: All numerical values are synthetic simulation data and are not derived from real patients or a completed community trial. They demonstrate an analytical model only.

The simulated progression illustrates why reporting screening volume alone can exaggerate program success. In the community pathway, 86% of participants are screened, but only 24% of the original cohort reaches the modeled care-initiation stage. Some attrition is appropriate because not every screened individual requires intervention, but additional losses between referral and diagnosis represent an implementation problem. Future field studies should therefore distinguish clinically appropriate attrition from avoidable loss to follow-up.

5.2 Retention Across the Hearing-Care Continuum

Graph 1 presents the simulated progression of the two pathways. The community-screening pathway maintains substantially greater engagement during initial screening and diagnostic follow-up. The separation between pathways continues through care initiation, suggesting that active community identification may be most useful when combined with structured referral navigation.

Graph 1: Simulated Retention Across a Community Hearing-Care Pathway



Source: Author-generated synthetic simulation. Values do not represent observed clinical outcomes.

The graph also shows that community screening does not eliminate attrition. Only a subset of initially invited individuals proceeds to care initiation because screening results, diagnostic eligibility, personal choice, access barriers, and clinical management decisions influence progression. This pattern is important for program design because an ethically responsible screening service should not pursue maximum intervention uptake irrespective of clinical need.

The appropriate interpretation is therefore that community screening could strengthen access and continuity, not that it automatically improves hearing or healthy-aging outcomes. Demonstrating actual health benefit would require prospective measurement of hearing-related communication, quality of life,

social participation, appropriate hearing-device use, functional outcomes, and potential unintended consequences.

6. Discussion

6.1 Community Screening as an Entry Point to Preventive Hearing Care

The simulated analysis suggests that the strongest contribution of community hearing screening may be its ability to bring hearing assessment closer to older adults who would otherwise remain outside specialist services. Conventional clinic-based audiology remains essential for diagnostic confirmation, but relying exclusively on self-initiated specialist attendance can miss individuals who have normalized gradual hearing decline or who experience logistical barriers to care. Earlier primary-care screening literature demonstrated that relatively brief screening procedures can identify substantial numbers of adults with possible hearing impairment.

Community implementation may also change the meaning of hearing assessment. When screening is incorporated into routine healthy-aging activities rather than offered only after a person complains of disability, hearing becomes part of preventive functional assessment. This framing can reduce dependence on individual help-seeking and may create opportunities for education concerning communication strategies, noise exposure, ear health, and the availability of rehabilitation.

However, screening should not be equated with diagnosis. Portable devices, questionnaires, or digits-in-noise tests have different measurement characteristics and may be influenced by testing environment, language, cognition, attention, and device conditions. Potgieter and colleagues specifically demonstrated that language competence and age influenced smartphone digits-in-noise performance, illustrating why locally appropriate validation and referral thresholds are essential.

6.2 Hearing Function as a Component of Healthy Aging

A second implication concerns the position of hearing within healthy-aging policy. Hearing impairment can reduce conversational access in precisely those situations through which many protective aspects of aging are maintained: family interaction, social participation, community activity, health-care communication, and engagement with cognitively stimulating environments. The systematic review by Shukla and colleagues found that hearing loss was commonly associated with loneliness and social isolation, while Lawrence and colleagues identified an association with depression. These relationships justify integrating communication assessment into comprehensive older-person care.

The relationship with cognition requires more careful interpretation. Observational studies have repeatedly associated hearing impairment with cognitive decline, and the 2020 Lancet Commission treated hearing loss as a potentially modifiable factor within a broader dementia-risk framework. Yet association does not establish that screening itself prevents cognitive decline. Common causes, reverse pathways, communication effects during cognitive testing, social mechanisms, and other factors can influence observed relationships.

Accordingly, community programs should avoid making exaggerated prevention claims. A defensible healthy-aging rationale is that identifying hearing impairment can create opportunities to improve auditory communication and connect older people with evidence-based hearing care. Potential

downstream effects on social participation, mood, cognition, or independence should be measured empirically rather than assumed.

6.3 Referral Completion, Equity, and Implementation Quality

The simulation highlights referral completion as a central program challenge. A screening campaign that identifies hearing difficulty without accessible diagnostic services may increase awareness while leaving the underlying access problem unresolved. Older adults may face transport costs, long waiting periods, limited audiology availability, device affordability problems, stigma, or uncertainty regarding the usefulness of treatment. Program quality should therefore be judged partly by the percentage of eligible screen-positive participants who complete appropriate follow-up.

Equity must also be considered during technological implementation. Smartphone hearing tests can improve scalability, but community programs should not assume that every older adult owns a compatible device, is digitally confident, or can complete a self-administered test independently. Smartphone screening research demonstrates technical promise, yet local language, age, device configuration, and user characteristics can influence performance. A community program should therefore retain non-digital alternatives and provide trained assistance when required.

Finally, hearing rehabilitation should remain person-centered. Not every identified hearing difficulty requires the same management, and not every older person will prioritize amplification. Counseling should address communication goals, daily-life difficulties, expectations, family communication, treatment options, and individual preferences. The role of community screening is to improve informed access to this decision-making process rather than to convert a screening result automatically into a particular device or intervention.

7. Conclusion

Community-based hearing screening offers a plausible strategy for strengthening healthy-aging services by identifying hearing difficulties among older adults who may not independently seek specialist care. Its public-health value lies primarily in improving access, awareness, and connection with appropriate diagnostic and rehabilitative services. Brief self-report, portable screening, and validated speech-in-noise approaches provide several possible entry mechanisms, but all require appropriate implementation standards and referral pathways.

The simulation developed in this study indicates how pathway-level outcomes can be evaluated. Under the hypothetical assumptions, screening completion increased from 61% in an opportunistic pathway to 86% in a structured community pathway, while diagnostic follow-up increased from 18% to 32% of the original cohort and care initiation increased from 12% to 24%. These differences are illustrative and must not be interpreted as measured clinical effects.

The broader healthy-aging relevance of hearing screening is supported by evidence linking hearing impairment with communication difficulties, social isolation, depression, and cognitive-aging outcomes. Nevertheless, screening should not be promoted through unsupported claims that it independently prevents dementia or other complex age-related conditions. Its direct purpose is earlier identification and improved access to appropriate hearing assessment and care.

Future empirical research should therefore evaluate screening accuracy, participation, diagnostic completion, patient acceptability, equity, cost, hearing-related quality of life, communication function, and longer-term service utilization. Community hearing screening is likely to contribute most effectively to healthy aging when it functions as the first stage of an accessible and person-centered hearing-care continuum rather than as a stand-alone testing campaign.

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