Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Sustainability and Spread of Multilayered Community-Based Suicide Prevention Programmes for Older Adults: Linkage Configurations Between Prevention Levels in a Comparative Analysis

Hirofumi Oyama

hoyama3676@gmail.com

Aomori University of Health and Welfare

Tomoe Sakashita

Aomori University of Health and Welfare

Research Article

Keywords: Suicide prevention, Aged, Implementation science, Diffusion of innovation, Program evaluation, Referral and consultation, Continuity of patient care, Linkage configuration, Community-based intervention, Multilevel intervention

Posted Date: November 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11327676/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Multilayered suicide prevention programmes combine components from two or more universal, selective, and indicated (USI) prevention levels. Such community-based programmes have been associated with reduced suicide mortality among older adults and often include linkages that enable transitions between prevention levels. Intervention content can shape sustainability and spread; how linkage configurations relate to these outcomes after evaluation remains unclear. We undertook a comparative implementation analysis of four programmes previously characterised by their USI components and linkages in a systematic review.

Methods

The fixed case set comprised four programmes represented by nine non-randomised intervention studies reporting reductions in suicide mortality. We traced peer-reviewed programme publications through targeted and forward-citation searches; institutional and research reports informed implementation chronology. Two researchers independently extracted data and coded linkage using predefined criteria: protocol-driven transitions between USI levels were systematic, those reliant on professional discretion or trust were relational, and those combining both were hybrid. They coded governance, sustainability, and spread, resolving disagreements by consensus. Evidence matrices supported cross-case comparison. We distinguished continued operation, implementation within established delivery systems, and reported adoption elsewhere. The Consolidated Framework for Implementation Research sensitised our assessment of context.

Results

All four operated for multiple years, with varied evidence of post-evaluation continuation. The Elderly Suicide Prevention Program (ESPP), with hybrid linkage, expanded to two additional clusters within Hong Kong's Hospital Authority, attaining territory-wide coverage; community depression screening (CDS), with systematic linkage, was reported across six Japanese municipalities, with later use of its model for middle-aged adults in five. Tele-Help/Tele-Check and the community group activity programme in Yuri (CGA-Y), both with relational linkage, were documented in Italy's Veneto region and Japan, respectively. The contrast between CDS and CGA-Y, considered alongside ESPP and Tele-Help/Tele-Check, is consistent with the hypothesis that systematic linkage pathways may be reproduced across sites more readily than relational linkages, although intervention content and context may contribute.

Conclusions

Documented sustainability and spread differed across cases. Linkage configuration may offer a useful construct for studying implementation separately from intervention content. Its role in transfer across delivery systems, and the role of governance in sustainability, require prospective testing in broader programme sets.

Contributions to the literature

- This study introduces linkage configuration, meaning how universal, selective, and indicated prevention levels are connected, and examines this feature over time in systematically identified programmes using published data.
- Across the four programmes, linkage configuration generated a testable hypothesis about transfer across delivery systems; its role relative to governance requires future confirmation.
- Relational linkage was observed in programmes with sustained operation within established delivery systems, but its transfer may require locally embedded relationships to be rebuilt, suggesting that sustainability and spread may involve different implementation conditions.
- The role of governance in sustainability remains uncertain and may be influenced by administrative scale, highlighting an important question for future research.

Background

Suicide among older adults remains a major public health concern worldwide, particularly in high-income countries experiencing rapid population ageing [1, 2]. Overall suicide rates have declined in recent decades, but this decline has not been consistent among adults aged ≥ 65 years [3], reflecting a complex interplay of psychological, physical, and social factors, particularly depression, physical illness, social isolation, and limited access to timely mental health care [4]. Prevention strategies have increasingly moved beyond clinical and institutional settings towards community-based approaches [5]. Gordon [6] proposed an operational classification of disease prevention into universal, selective, and indicated (USI) components, which Mrazek and Haggerty [7] later applied to mental health. Building on this classification, a schematic model mapped four sequential stages of suicide progression—a non-suicidal state, suicidal ideation, suicidal plans, and suicidal acts—onto USI prevention strategies and indicated where explicit linkages between adjacent levels had been reported in previous evaluations (Fig. 1) [8]. Neither the model nor the original USI classification, however, addressed the mechanisms by which individuals move between levels in implemented multilayered programmes. This gap persists despite evidence that multilayered strategies linking USI components may be needed for population-level impact, because single-component interventions such as means restriction and media guidelines may be insufficient on their own to achieve sustained reductions in suicide mortality among older adults in many settings [1, 9, 10]. Most reported multilayered programmes do not explicitly operationalise these linkages.

The characteristics of intervention components—including adaptability, complexity, and relative advantage—are recognised determinants of sustainability and spread [11–13], but recent reviews indicate that less attention has been paid to how programmes are integrated within organisational and professional

contexts and consequently maintained and extended in practice [9, 10, 14]. A recent systematic review of complex, multilayered and multicomponent suicide prevention interventions found inconsistent and incomplete use of implementation science approaches, highlighting persistent gaps in understanding how such programmes operate in practice [15]. The linkages enabling transitions between prevention levels may be formal or informal [16], a distinction previously described qualitatively but not yet operationally classified or examined in relation to governance arrangements and implementation outcomes; such linkages may differ in operational structure and organisational embedding, with implications for programme persistence [12, 17, 18]. This distinction aligns with Proctor et al.'s [17] separation of clinical outcomes, attributed to interventions, from implementation outcomes, attributed to implementation processes: mechanisms operating along the pathway to care are analytically distinct from the interventions they connect [19–22]. We conceptualised linkage configurations as structural arrangements between prevention levels, distinct from change-inducing intervention activities, and as a candidate implementation construct for examining sustainability and spread. Linkage configuration is treated descriptively, not as a causal implementation mechanism linking strategies to outcomes [23]. Sustainability [17, 18] and spread [13] are distinct dimensions with different policy implications. Building on previous work indicating that structural linkages between prevention levels are associated with greater reductions in suicide mortality [8], we used a comparative implementation analysis to examine how different types of linkage between USI prevention levels, under varying governance arrangements, may relate to the sustainability and spread of previously reported community-based suicide prevention programmes for older adults.

Methods

Study design

This study was a partial, comparative, secondary implementation analysis of previously reported community-based suicide prevention programmes. The analysis focused on two distinct aspects of implementation—sustainability [17, 18] and spread [13]—and examined implementation context and linkage configurations between prevention levels rather than re-evaluating clinical effectiveness. Reporting was informed by the Standards for Reporting Implementation Studies (StaRI) guidelines [24], emphasising implementation context, processes, and outcomes, particularly linkage configurations and governance arrangements; the completed checklist is provided as Additional file 1.

The study aimed to generate hypotheses about relationships among linkage configurations, governance arrangements, and implementation outcomes for testing in future prospective studies. The four-case design is consistent with multiple-case research, in which analytical replication and depth are prioritised over statistical representativeness [25].

Case selection

The programme was the unit of analysis because each programme represented a distinct, internally coherent configuration of intervention components and linkage arrangements implemented within a defined organisational context and governance arrangement.

Sakashita and Oyama [16] conducted a systematic review characterising intervention components and linkages across USI levels in community-based suicide prevention programmes for older adults, applying eligibility criteria relating to age (≥ 60 years), USI component combinations, and non-randomised comparative cohort designs—concurrent matched controls in most cases, a historical control for ESPP, and comparison with general-population rates for Tele-Help/Tele-Check. The review identified nine independent intervention studies, corresponding to four distinct programmes across three countries, that documented population-level reductions in suicide mortality. Because sustainability and spread are long-term phenomena that a single review cannot capture at a single time point, the present study retrospectively reviewed later publications concerning the same set of programmes rather than undertaking a new systematic search. This design is consistent with the theoretical replication logic used in multiple-case implementation research [25]. The nine suicide-mortality studies identified in our earlier systematic review provided a pre-existing case set for the present retrospective comparison of four programmes' reported sustainability and spread. It also meant that the present study did not search for programmes emerging after 2022, a limitation discussed in the Strengths and limitations subsection.

For the present study, an additional criterion, the availability of structural analyses describing intervention components and linkage arrangements, was applied to this set of programmes to identify information-rich cases suitable for cross-case comparison [26]. All four programmes met this criterion: Tele-Help/Tele-Check in Italy [27], the Elderly Suicide Prevention Program (ESPP) in Hong Kong [28], the community group activity programme in Yuri, Japan (CGA-Y) [29], and community depression screening (CDS) programmes across Japanese municipalities [30], the last comprising six replications with geographically matched control populations. Later peer-reviewed sources were examined for indications of service continuity beyond the evaluations: a Tele-Help/Tele-Check investigator discussed the service [31], and a 2022 protocol named ESPP's Fast Track Clinic as a referral pathway [32]. We identified these publications through targeted searches using programme and place names and forward-citation searches of the original evaluations. They were consulted to assess later references to the programme services identified in the 2022 review, not to identify additional eligible programmes systematically. Restricting the evidentiary basis for programme classification to peer-reviewed, published literature was deliberate and was intended to support independent verification of the classification procedure.

Across the four programmes, selective components shared a function of risk-targeted engagement through depression assessment (CDS), PHN-encouraged group activities (CGA-Y), care-manager contact (ESPP), or regular telephone calls (Tele-Help/Tele-Check). Indicated responses—clinical follow-up in CDS and ESPP, and crisis response in ESPP and Tele-Help/Tele-Check—formed part of those programmes, whereas CGA-Y relied on routine municipal public-health services when such care was needed. This functional commonality supported comparison of linkage configurations, with differences in activities and governance arrangements considered in the interpretation; generalisation was analytical rather than statistical.

Data sources and extraction

Data were extracted primarily from peer-reviewed studies and protocols relating to the four programmes [27–33]. Two non-peer-reviewed institutional and research reports identified while tracing the four programmes supplemented evidence on implementation chronology and post-evaluation activity (Additional file 2). They were not used to reassess effectiveness or determine linkage or governance classifications; these reports were identified through targeted follow-up rather than a systematic search. A structured data extraction process was used to promote consistency across programmes. For the CDS programme, sources included both the original evaluations in an older-adult population [30] and a subsequent replication in a middle-aged population using the same intervention model [33], providing evidence of transfer to a different age group. Extraction focused on programme components, linkage arrangements between prevention levels, organisational context, and governance arrangements. For sustainability and spread, we extracted the period of documented operation, reports of post-evaluation core-service continuation, implementation extent, and any reported adoption elsewhere, recording the source and period each described and distinguishing direct reports from suggestive references or judgements not addressed in cited sources. To enhance rigour, two researchers independently extracted and coded the data using predefined operational definitions derived from the analytical framework. The definitions were applied consistently across cases, and discrepancies were resolved through iterative discussion until consensus was reached. Extracted data were organised in a comparative matrix to support structured cross-case analysis. Analytical credibility was further supported by triangulating data sources to corroborate classifications and contextual interpretations. An evidence-to-coding matrix showing the source evidence, extracted features, operational criteria, and final classifications for linkage configuration and governance is provided in Additional file 3.

Analytical framework

We used an analytical framework centred on the USI model [6] and linkage configurations [8] to examine previously reported community-based suicide prevention programmes and the role of linkage configurations as candidate implementation constructs within mental health systems. The Consolidated Framework for Implementation Research (CFIR) [12], subsequently updated [34] with a complementary Outcomes Addendum [35], was used as a sensitising framework for contextual domains rather than to define outcomes. CFIR therefore provided an organising structure for the bespoke categories developed in this study, alongside implementation outcome frameworks focused on sustainability and spread [17, 18].

We defined interventions as structured activities designed to reduce suicide risk by directly addressing psychological, social, or clinical risk factors in target populations or individuals [6, 7]. Both interventions and linkage configurations were defined functionally—that is, by what they do rather than by their specific form. For analytical purposes, equivalent instances within each category were treated as functionally interchangeable: interventions when addressing equivalent preventive targets, and linkage configurations when enabling equivalent transitions between prevention levels. This shared functional emphasis also distinguishes the two constructs. Although the Practical, Robust Implementation and Sustainability Model (PRISM) recognises seamless transition between programme elements, this concept has rarely been operationalised empirically [36]. We defined linkage configurations more specifically as structural arrangements within the USI model through which transitions between prevention levels are organised or facilitated within a programme [8]. Thus, linkage configuration is an analytic construct describing transition pathways, not a causal implementation mechanism [23]. Like implementation processes in Proctor et al.'s [17] framework, and consistent with the distinction between continuity-of-care processes and the care they connect [21], linkage configurations operate along the pathway to care rather than on the person receiving it. Linkage configurations therefore do not primarily function as change-inducing activities; observed change is more likely to reflect the properties of the intervention to which the linkage provides access. Intervention components act on preventive targets, whereas linkage configurations operate on the pathways connecting those components.

Drawing on previous descriptions of formal and informal linkage types and governance structures across programmes [16], and guided by the CFIR distinction between inner setting (organisational context) and outer setting (governance arrangements), we operationalised the analytical framework along two functional dimensions: linkage configurations within programmes, considered in relation to the CFIR inner setting, and governance arrangements beyond programmes, considered in relation to the outer setting. Within the inner setting, we focused on the programme-level processes through which linkages are enacted. We treated these processes as internal to the programme's operational structure rather than products of external governing authority and distinguished formal referral-based connections from informal relationship-based connections [16]. We classified systematic linkages as protocol-driven pathways that structure transitions through predefined institutional procedures, and relational linkages as pathways that rely on professional discretion and interpersonal trust to facilitate transitions between prevention levels (see Table 1, "Linkage configuration" column, for programme-specific examples). Within the outer setting, we examined governance arrangements that determine organisational authority and mandate. We distinguished institutional arrangements, embedded in administrative mandates and public funding, from autonomous arrangements, driven by the self-determined missions of independent organisations [16]. We selected these dimensions for the analytical matrix (Fig. 2) to compare within-programme transition pathways separately from the external governance arrangements supporting programme delivery. We used established terminology to describe intervention uptake (adoption) and integration into routine service structures (penetration).

Table 1
Key characteristics, target populations, and contextual features of four suicide prevention programmes

Programme	Governing administrative level	Population coverage (population evaluated for suicide-rate outcomes)	Primary target population	Primary prevention levels	Duration of documented operation (evaluation period)	Core components	Linkage configuration	Main delivery agents
Tele-Help/Tele-Check, Veneto, Italy (suicide-mortality evaluation in Padua) [27]	Regional	Approx. 200 000 residents; 18 641 enrolled users over 11 years (cohort vs. general-population rates)	Older adults living alone or with functional impairment	Selective + Indicated	1988–1998 (evaluation period); appears to have been integrated into regional public health services	Emergency alarm system; regular telephone monitoring and emotional support	Selective to indicated: user-initiated emergency alarm supported by relational familiarity; 24/7 monitoring available throughout the operational period	Trained staff (facilitators); s services
Elderly Suicide Prevention Program (ESPP), Hong Kong [28]	Territory-wide	Approx. 6.98 million residents; 351 individuals over a 2-year follow-up (cohort vs. historical control)	Older adults with depression, suicidal ideation, or suicide attempts	Selective + Indicated	2002–2007 (evaluation period); implemented within a government-led mental health service framework	Depression treatment; gatekeeper training; care management; aftercare	Selective to indicated: hybrid linkage combining systematic referrals to psychogeriatricians with continuous relational monitoring and user-initiated direct emergency access	Care managers psychogeriatric primary care gatekeepers
Community group activity programme, Yuri (CGA-Y), Japan [29]	Municipal	Small rural municipality (< 15 000 residents); average 1 601 annually (cohort vs. matched municipal controls)	Older adults with poor social relationships	Universal + Selective	1995–2002 (8-year documented evaluation period)	PHN-led group-based social and recreational activities; accompanying mental health workshops and depression self-assessment	Universal to selective: relational linkage mediated by PHNs through continuous community engagement and encouragement to participate in group activities; professional identification of individuals at risk as the primary transition pathway	PHNs; local volunteers
Community Depression Screening (CDS), six independent northern municipalities, Japan [30]	Municipal	< 15 000 residents per municipality; average 439–14 578 annually, varying by municipality (cohorts vs. matched municipal controls)	Community-dwelling older adults (with follow-up for individuals with positive screening)	Universal → Selective → Indicated	2 to 10 years across the six studies (evaluation periods varied by municipality)	Two-step depression screening; psychiatric or primary care follow-up; public education	Universal to selective and selective to indicated: systematic, protocol-driven linkage through structured invitations to secondary screening and referrals to subsequent care within screening cycles	Municipal PHN local primary c physicians; ext psychiatric specialists

Notes: PHN = Public Health Nurse. → sequential progression; + concurrent operation.

Comparative analysis

To support construct validity across culturally and institutionally diverse settings, linkage configurations were defined solely by their structural and operational characteristics, namely the pathways by which individuals transition between prevention levels. This definition supported consistent cross-case comparison despite differences in national health systems, cultural norms, and implementation periods. The analysis proceeded in three stages: data extraction, cross-case comparison, and interpretation of how structures related to sustainability and spread. Coding and categorisation followed a framework-based approach that combined predefined analytical dimensions (linkage configurations, governance arrangements, and implementation outcomes) with iterative identification of emergent patterns. Coding outputs were organised in structured comparative matrices to support cross-case synthesis. Two researchers independently reviewed and coded the data, resolving discrepancies through discussion to reach consensus. Coding decisions and category definitions were documented to support transparency and reproducibility.

Programme components and prevention levels were classified according to the USI framework [8], whereas linkage configurations were classified using operational definitions informed by previous descriptions of linkage types [16].

For each programme, we examined five CFIR domains [12, 34] as a common framework for cross-case comparison using framework-based qualitative analysis [37]: intervention characteristics, inner setting (organisational context and workflows), outer setting (governance arrangements), characteristics of individuals involved, and implementation processes. Within the characteristics-of-individuals domain, we examined both service users (age group, assessed risk level, and patterns of service uptake) and programme staff (professional roles, discretion, and level of involvement) to assess whether and how they shaped activation of linkage configurations between prevention levels.

These domains were examined to provide the empirical basis for classification, and each programme was assessed across four dimensions. The first two—dominant linkage configuration (systematic, relational, or hybrid) and governance arrangement (institutional, autonomous, or hybrid)—were derived from the two axes of the analytical matrix. CFIR contextualised these dimensions within organisational and governance-related conditions rather than defining the dimensions themselves. The remaining two dimensions—sustainability [17, 18] and spread [13]—were the primary implementation outcomes of interest. Linkage configurations were classified as systematic when participant transitions were protocol-driven and structured through predefined procedures; relational when transitions depended on interpersonal trust or professional discretion, including professional encouragement of participation and service user self-referral; and hybrid when both systematic and relational linkage types were present. Governance arrangements were classified as institutional when programmes operated under an administrative mandate with public funding, including national policy mandates delegated to municipal governments; autonomous when driven by an independent organisational mission without a public mandate; and hybrid when public-sector leadership coexisted with outsourced operational delivery.

Each programme was then labelled by the combination of its dominant linkage configuration and governance arrangement (e.g., systematic-institutional), indicating its position within the analytical matrix (Fig. 2). These categories represent conceptual poles and intermediate positions rather than exhaustive empirical categories, and not all matrix positions were represented. Where reported, indicators of individual transitions between prevention levels, such as completeness and promptness, were used descriptively to characterise programme processes. Because reporting was inconsistent across programmes, these indicators were not treated as a comparative measure of linkage quality.

Sustainability was defined as continuation of programme activities beyond the initial implementation period, distinguishing core-service continuation from continuation across all sites [17]. Implementation extent, subsequent adoption by different sites, and extension to new populations were recorded separately; cross-case comparisons examined the documented forms of implementation in each setting, with subsequent adoption and population extension noted where evidence permitted. The governing administrative level, reported implementation extent, and subsequent adoption beyond an established delivery system were treated as distinct characteristics. ESPP's seven regional services operate within a single Hospital Authority; this and other instances of implementation extent were not treated as evidence of transfer to independent delivery systems. An evidence-to-outcome correspondence table (Additional file 2) documents these judgements. Because reporting was heterogeneous across sources and programmes, these outcomes were compared qualitatively rather than quantified on a common scale. Together, this case set, predefined operational definitions, and the evidence-to-coding matrix (Additional file 3) were intended to reduce reliance on post-hoc case classification.

Results

Overview of programmes

We analysed four community-based suicide prevention programmes through nine independent intervention studies. Each programme was associated with reductions in population-level suicide mortality [27–30] and integrated combinations of universal, selective, and indicated prevention components through specific linkage arrangements (Table 1). Figure 3 summarises the pathways connecting these components within each programme, corresponding broadly to systematic and relational linkage.

[Table 1 about here]

The Tele-Help/Tele-Check programme in Italy and ESPP in Hong Kong were two-tiered models linking selective and indicated prevention. Tele-Help/Tele-Check provided low-threshold emotional support and user-initiated crisis response through trained staff, whereas ESPP combined structured referral pathways with ongoing monitoring; indicated care was delivered through affiliated psychogeriatric services and non-governmental organisations. The CGA-Y programme in Japan centred on public health nurse (PHN)-led group activities, accompanied by mental health workshops and depression self-assessment, linking universal and selective prevention through community engagement [29]. The original evaluation suggested that approximately half or more of older residents participated in at least one programme activity during implementation [29]. The CDS programmes in Japan used a three-tiered strategy integrating universal, selective, and indicated prevention through a standardised two-step screening protocol with clinical follow-up. CDS was implemented across six municipalities with a systematic-institutional linkage configuration [30]. Peak annual first-stage screening participation approached or exceeded 80% in five of the six studies (approximately 50% in the remaining study); peak second-stage participation was around 80% in four studies (around 60% in the other two) [30].

Operationally, linkage configurations differed across programmes. Relational models such as CGA-Y and Tele-Help/Tele-Check relied substantially on the professional discretion of boundary spanners who maintained trust-based relationships; CDS used systematic linkages embedded in formal workflows; and ESPP combined systematic and relational elements in a hybrid configuration.

Governance and delivery models also differed. Tele-Help/Tele-Check operated under a hybrid governance model combining regional public funding with outsourced operational delivery; ESPP operated under institutional governance within a centralised health system; CGA-Y relied on municipal public health infrastructure; and CDS operated within systematic-institutional municipal frameworks (Fig. 2).

Cross-case comparison of linkage configurations and governance arrangements

Cross-case comparison identified distinct patterns in linkage configurations and governance arrangements across the four programmes. Table 2 builds on Table 1 by illustrating the contrasts between relational and systematic linkage configurations (including hybrid forms) and between institutional and hybrid governance arrangements. These patterns are contextualised using the CFIR inner- and outer-setting domains and provide a basis for examining their relationships with sustainability and spread.

Table 2
Contextual comparison of linkage configurations across four community-based suicide prevention programmes

CFIR domain	Tele-Help/Tele-Check (Italy)	ESPP (Hong Kong)	CGA-Y (Japan)	CDS (Japan)
Intervention characteristics	Low-threshold emotional support and crisis-response service. User-initiated contact is central. Relational continuity is prioritised over protocol-driven escalation.	Two-tiered selective-indicated model. Structured referral to psychogeriatric services is combined with relational monitoring by care managers.	PHN-led community-based group activities. Emphasis is placed on ongoing engagement and early identification through sustained presence.	Three-tiered universal-selective-indicated model. Standardised two-step depression screening is embedded in municipal workflow.
Inner setting	Relational linkage configuration. Crisis transitions are largely user-driven. Delivery depends on trained staff maintaining familiarity and trust.	Hybrid linkage configuration. Institutional referral pathways predominate, combined with relational monitoring by care managers that allows professional discretion.	Predominantly relational configuration. Linkage is embedded in routine outreach and ongoing engagement rather than formal escalation procedures.	Systematic linkage configuration. Formal PHN-physician referral is governed by predefined protocols within screening cycles.
Outer setting	Hybrid governance. Publicly funded regional mandate with outsourced operational delivery by an external organisation.	Institutional governance embedded in the public health system. Integration within hospital-based psychogeriatric services and affiliated non-governmental organisations.	Municipal governance embedded within institutional administrative systems. Continuity depends on local administrative support and PHN workforce structure.	Institutional governance within municipal administrative systems. Continuity depends on municipal-level administrative stability and resource allocation.
Characteristics of individuals	Staff require relational competence and crisis-management skills. Effectiveness was linked to interpersonal continuity.	Care managers balance structured referral protocols with relational engagement. Clinical discretion operates within institutional boundaries.	PHNs exercise substantial professional autonomy. Trust-building is central to identification and engagement.	PHNs and collaborating physicians operate within clearly defined screening and referral roles.
Implementation process	Adaptation occurred pragmatically within a stable regional mandate, while continuity was maintained through organisational integration. Process continuity depended on organisational resilience.	Institutional support facilitated implementation across seven regional services and territory-wide standardisation.	Gradual development occurred through local engagement; subsequent adoption elsewhere was not addressed in the cited sources.	Implementation occurred across six municipalities over evaluation periods of 2–10 years.

Notes: CDS = Community depression screening; CFIR = Consolidated Framework for Implementation Research; CGA-Y = Community group activity programme in Yuri, Japan; ESPP = Elderly Suicide Prevention Program; PHN = Public Health Nurse. Table rows use CFIR domain labels as an organising structure; cell content reflects the bespoke categories developed for this study rather than exhaustive CFIR coding.

[Table 2 about here]

Tele-Help/Tele-Check operated under a hybrid governance arrangement and prioritised low-threshold emotional support delivered by trained staff. Transitions between prevention levels were primarily user-initiated and crisis-driven, relying on relational familiarity rather than predefined escalation protocols. ESPP functioned within a centralised, government-led framework, combining systematic referral pathways to psychogeriatricians with relational monitoring and user-initiated emergency access. These institutional protocols permitted professional discretion, indicating a hybrid linkage configuration. CGA-Y operated within a municipal framework but relied mainly on professional autonomy and sustained community engagement, with linkage occurring through informal relational processes embedded in routine outreach rather than protocol-driven transitions. CDS was implemented within municipal administrative systems around a structured screening workflow; formal protocols connected PHNs and physicians, and transitions occurred as discrete protocol-driven events, indicating a systematic linkage configuration. Collectively, these patterns illustrate contrasting linkage configurations and governance arrangements across the framework's two analytical dimensions.

Implementation outcomes: sustainability and spread

Patterns of sustainability and spread differed across linkage configurations (Table 3). All four programmes operated over multiyear evaluation periods spanning 2 to 11 years; evidence for continuation after these periods differed in strength (Additional file 2). These later reports are consistent with continuation of related services in some form [31, 32], although neither specifies whether the original programme components and scope were maintained. Subsequent application of the CDS model to middle-aged adults in five municipalities was reported [33]. Following a municipal merger, middle-aged screening was implemented in the merged municipality and subsequently introduced in four other Aomori municipalities; some community education activities continued for a period in parts of the former Yuri area [38] (Additional file 2). These observations suggested possible relationships between sustainability, linkage configuration, and governance but did not establish them. ESPP was reported across seven regional services and CDS across six municipalities [28, 30], with linkage integrated into standardised workflows within their respective health or municipal systems. In some contexts,

establishing the necessary professional infrastructure, including coordination between primary care and specialist services, appeared more complex for CDS. These cross-case patterns were used to generate propositions about linkage configuration and transferability rather than to support causal inference.

Table 3
Linkage configurations and implementation outcomes across the four programmes

Programme	Linkage configuration	Governance arrangement	Sustainability	Reported implementation extent and spread
Tele-Help/Tele-Check (Italy)	Relational (user-initiated crisis response; ongoing familiarity)	Hybrid (public mandate and outsourced operational delivery)	Multiyear operation was documented within the Veneto regional system; later evidence suggested continuity, although continuation of the programme as a whole was not established.	The suicide-mortality evaluation was based in Padua; the source also describes the service at a broader Veneto regional level [27]. Subsequent adoption elsewhere was not addressed in cited sources.
ESPP (Hong Kong)	Hybrid, with systematic referral as the primary transition pathway and relational follow-up as a supporting layer	Institutional (embedded in the public health system with collaboration from non-governmental organisations)	Multiyear operation was documented under centralised health-system governance; a later protocol described an ongoing referral pathway, without establishing continuation of the ESPP as a whole.	Expansion to the Hong Kong West and Kowloon East Clusters in 2003/04 completed territory-wide coverage within the Hospital Authority (Additional file 2); seven regional services were reported [28].
CGA-Y (Japan)	Relational (professional discretion and sustained outreach)	Institutional (municipal public health framework)	Documented in Yuri during 1995–2002; community education activities continued for a period in parts of the former Yuri area [38]; continuation of the CGA-Y programme as a whole was not established.	Reported implementation was confined to Yuri municipality; subsequent adoption elsewhere was not addressed in cited sources
CDS (Japan)	Systematic (protocol-driven screening and formal referral pathways)	Institutional (municipal administrative integration)	Documented during evaluations lasting 2–10 years; municipality-specific post-evaluation continuation was not established in cited sources.	Implementation across six municipalities was reported [30]; subsequent application of the same model to a middle-aged population across five municipalities was confirmed [33]. Following a municipal merger, middle-aged screening was implemented in the merged municipality and subsequently introduced in four other Aomori municipalities [38].

Notes: CDS = Community depression screening; CGA-Y = Community group activity programme in Yuri, Japan; ESPP = Elderly Suicide Prevention Program. Linkage configuration describes the dominant arrangement connecting prevention levels within programmes: systematic (protocol-driven screening and referral pathways), relational (interpersonal relationships and professional discretion), or hybrid (a combination). Governance arrangement describes the context beyond the programme and was considered in relation to the CFIR outer setting. Sustainability and spread were defined and assessed as described in Methods (Comparative analysis subsection).

[Table 3 about here]

By contrast, relational configurations such as CGA-Y and Tele-Help/Tele-Check showed sustained operation within their respective delivery systems, supported by PHN involvement in CGA-Y [29] and regional health and social care integration in Veneto for Tele-Help/Tele-Check [27]. Adoption beyond those systems was not established in the cited sources (Additional file 2).

Synthesis of implementation patterns

Theoretical saturation was not a formal criterion because the study was hypothesis-generating. However, the four programmes represented the full set identified in the 2022 review that met the present selection criteria, and the cross-case comparison described variation in linkage configurations and reported implementation across settings (Fig. 2; Table 3). Tele-Help/Tele-Check [27], with hybrid governance and relational linkage, and CGA-Y [29], with relational linkage embedded in a municipal institutional framework, both showed sustained operation within their respective delivery systems during their documented periods. ESPP expanded to Hong Kong West and Kowloon East in 2003/04, completing territory-wide coverage [39]; the peer-reviewed evaluation separately described implementation across seven regional services [28]. CDS was reported across six municipalities [30], with linkage integrated into standardised workflows in both programmes. The timing and pathways of adoption were not consistently reported across programmes. The implementation of CDS across six municipalities, compared with CGA-Y as documented within Yuri, was consistent with the hypothesis that codifiable linkage may facilitate implementation across separate municipalities. Participation in first- and second-stage screening and in group activities provides indirect evidence of engagement rather than direct measures of linkage quality.

Discussion

Principal findings

The study contributes conceptually by proposing linkage configurations—structural arrangements through which transitions between prevention levels are organised rather than interventions acting directly on individuals—as a candidate implementation construct that may help explain differences in sustainability and spread across community-based suicide prevention programmes. This comparative implementation analysis of four community-based suicide

prevention programmes, all associated with reduced suicide mortality among older adults, supports their comparability while demonstrating substantial diversity across two analytical dimensions: linkage configuration and governance arrangement. The case set identified in the previous review includes two Japanese municipal programmes sharing institutional governance but differing in linkage configuration; the Italian and Hong Kong programmes provide additional service contexts.

All four programmes operated over multiyear evaluation periods, but their reported implementation took different forms. ESPP's hybrid linkage configuration combined systematic referrals with relational monitoring across seven regional services of Hong Kong's Hospital Authority; CDS's systematic linkage configuration was reported across six Japanese municipalities. Tele-Help/Tele-Check and CGA-Y, both with relational linkage configurations, were documented in Italy's Veneto region and Japan's Yuri municipality, respectively. The shared selective function evident in Table 1, alongside indicated responses delivered within three programmes or through routine municipal public-health services in CGA-Y, provides a basis for analytical comparison while allowing for differences in programme delivery. ESPP expanded to additional clusters within the Hospital Authority [39], whereas adoption of Tele-Help/Tele-Check beyond Veneto was not established in the cited sources. Among the two Japanese municipal programmes, the CDS–CGA-Y contrast, considered alongside the less directly comparable observations for ESPP and Tele-Help/Tele-Check, is consistent with the hypothesis that codifiable screening and referral pathways may be adopted by separate municipalities more readily than linkages relying on locally established professional relationships. This proposition applies the diffusibility logic of codifiable and tacit knowledge [13] to linkage pathways and is compatible with context-sensitive adaptation during sustainment [11]. Intervention content and clinical infrastructure remain possible explanations. Continued operation within an established delivery system does not necessarily lead to adoption elsewhere; sustainability and spread may therefore follow different trajectories [13, 18].

Because post-evaluation continuation was reported unevenly, the contribution of governance to longer-term sustainability could not be compared reliably across the four programmes.

Linkage context, sustainability, and spread

Our analysis suggests that linkage between prevention levels is context dependent and shaped by professional roles and organisational alignment rather than constituting a uniform mechanism, consistent with previous research identifying contextual fit and adaptability as key facilitators of suicide prevention implementation [14].

Post-evaluation reports indicate partial continuation or adaptation in CDS and CGA-Y, but do not establish that all components of the original programmes continued [38]. Sustained operation during the documented evaluation periods may be interpreted through normalisation process theory, whereby interventions become routine work through high coherence and cognitive participation [40]. In CDS and CGA-Y, Japanese public health nurses supported both programmes as part of broader preventive health activities [41]. This close collaboration between frontline staff and external experts during planning and implementation is consistent with evidence supporting successful implementation [13]. Ongoing professional support and collaboration may therefore have contributed to institutionalisation over time. The diversity of linkage configurations is consistent with differences in local organisational and governance conditions.

Beyond the implementation extent summarised above, the CDS model was subsequently applied to a middle-aged population across five municipalities [33]. CDS's implementation across municipalities and later adaptation, alongside ESPP's expansion within the Hospital Authority, suggest that codifiable systematic pathways may have contributed to implementation across sites, including as the referral component of ESPP's hybrid configuration [28, 30, 33, 39] (Additional file 2). In CDS, standardised screening and referral steps may have been easier to reproduce across municipalities because public health nurses could enact them through established municipal outreach and follow-up roles [30, 41]. At the selective level, regular telephone contact and group activities in Tele-Help/Tele-Check and CGA-Y, respectively, are familiar activities unlikely by themselves to require specialised infrastructure or constitute a substantial barrier to replication. Their content alone therefore seems unlikely to explain the narrower documented spread of the relational programmes (Table 3; Additional file 2), although reproducing the full programmes may involve additional staffing or technical requirements. CGA-Y's estimated participation across programme activities suggests substantial local reach in the setting where suicide mortality declined among older women, although the contributions of reach and individual components cannot be isolated [29]. The cited sources do not establish whether either relational programme was adopted elsewhere. Pre-existing community infrastructure could mitigate such barriers [42]. Transferring a relational linkage configuration may take time to build local trust and tacit expertise, consistent with the gradual, engagement-dependent development observed in CGA-Y (Table 2).

The difference between CDS's implementation across separate municipalities and ESPP's expansion within one Hospital Authority limits direct comparison of their spread across independent delivery systems. Beyond the present cases, the analytical framework may also help interpret programmes that achieve broad dissemination without explicitly designed linkages [9, 10]: the absence of formalised transition pathways or professional backup structures may have implications for the durability of population-level effects on suicide outcomes.

Frontline staff as boundary spanners

Across the four programmes, frontline staff performed boundary-spanning roles [43], bridging community-based prevention with clinical or supportive services and contributing to continuity across service settings. In relational configurations, continuity depended partly on professional discretion and trust-based networks. These roles can support engagement of individuals at increased risk but depend on local professional relationships, which may limit transferability across jurisdictions in relational configurations [13].

Tele-Help/Tele-Check illustrates non-clinical indicated prevention: frontline staff functioned as boundary spanners, responding to acute suicide risk through immediate, relationship-based crisis support rather than formal medical treatment, while access to clinical care occurred outside the programme when considered necessary. This example suggests that the boundary-spanning role of frontline staff is not limited to mediating transitions between community-based prevention and clinical services; it may also involve sustaining non-medical pathways capable of interrupting acute risk.

By contrast, CDS operated with a predominantly systematic linkage configuration under institutional governance, with limited reliance on informal or relational pathways. This may be relevant to its implementation across multiple municipalities. The boundary-spanning role also differed by staff function: municipal PHNs supported CDS and CGA-Y, with external clinicians additionally involved in CDS, whereas care managers and trained facilitators supported ESPP and Tele-Help/Tele-Check, respectively.

Divergent roles of linkage configuration and governance

The cross-case pattern suggests that linkage configuration may be particularly relevant to transferability across organisational boundaries, whereas the role of governance in sustainability remains uncertain. Distinguishing interventions from linkage configurations, consistent with Proctor et al.'s [17] separation of clinical and implementation outcomes, may therefore help examine sustainability and spread separately. More standardised linkage configurations may be more readily transferable across organisational boundaries than configurations that depend heavily on local professional relationships. However, linkage configuration, governance arrangement, administrative scale, intervention content, and health-system context were partly confounded across the four cases. These observations should therefore be interpreted as hypothesis-generating propositions, not as evidence that linkage configuration independently determines spread or that governance determines sustainability.

For practitioners, linkage standardisation may guide programme adaptation. Relational linkages may require rebuilding trust, whereas systematic configurations may facilitate replication but require infrastructure. The best configuration may depend on context not examined here. WHO/ExpandNet guidance emphasises assessing local fit before scaling [44], a consideration relevant to further implementation of CDS. This challenge is not unique to older adults; a comparable gap exists in youth suicide prevention [45].

Strengths and limitations

This study has several strengths. The four programmes had sufficiently long operational histories for longitudinal analysis, with comparative designs (see Case selection) spanning multiple years and eligible populations in the thousands, providing a basis for cross-case analysis. The four programmes constituted the complete pre-established case set meeting the present criteria within our 2022 systematic review [16], rather than a convenience sample selected for the current analysis. The sample varied in linkage configurations and governance arrangements. Conceptualising sustainability as graded rather than binary improves theoretical precision.

However, this study has some limitations. The absence of unsuccessful interventions limits our ability to determine causal relationships and may introduce selection bias, given the focus on information-rich or successful programmes. In addition, because the study followed a set of programmes identified through a systematic review published in 2022, no new systematic search was conducted for programmes emerging or documented after that time. The four cases should therefore be understood as a specific, previously identified set followed longitudinally rather than a currently exhaustive set of eligible programmes. None of the four programmes represented a purely autonomous governance arrangement; although this category was conceptually defined, it was not empirically represented in the sample. This absence may reflect a structural constraint rather than a sampling gap: because population-level suicide prevention is not commercially viable, sustained purely autonomous initiatives without public funding may be inherently difficult to establish at scale. The findings should therefore be interpreted as analytically informative patterns rather than exhaustive causal explanations and require testing in future prospective studies. Cross-cultural variation in social norms and health-system differences could not be fully disentangled from linkage and governance configurations. Although two non-peer-reviewed reports supplemented implementation chronology, targeted retrieval may have missed administrative records of adoption decisions and linkage transfer; future studies should prespecify criteria for identifying and corroborating such records. Some interventions were implemented in only one or a few local settings, so the observed configurations should be regarded as context dependent. Reliance on secondary data may also have introduced reporting bias and limited insight into informal dynamics. Intervention content and quality may influence effectiveness and sustainability [8], but disentangling these effects was beyond the scope of the present analysis. The study's primary contribution is therefore conceptual rather than empirical: it introduces linkage configuration as an analytically distinct implementation construct within the USI model for operationalisation and testing in future prospective studies using primary data.

Conclusions

This hypothesis-generating comparative analysis proposes linkage configuration as a candidate implementation construct, distinct from intervention content, for describing how multilayered programmes connect universal, selective, and indicated prevention levels in practice. Across the four cases, reported implementation patterns differed alongside linkage configurations, raising the hypothesis that linkage configuration may affect transfer across delivery systems. The role of governance arrangements in sustainability remained uncertain. These cross-case patterns should not be interpreted as independent causal effects. Future prospective comparative studies should test whether linkage configuration is associated with sustainability and spread after accounting for intervention content, governance, organisational context, administrative scale, and implementation capacity.

Abbreviations

CDS
Community depression screening
CFIR
Consolidated Framework for Implementation Research
CGA-Y
Community group activity programme in Yuri,Japan
ESPP

Elderly Suicide Prevention Program
PHN
Public Health Nurse
PRISM
Practical,Robust Implementation and Sustainability Model
StaRI
Standards for Reporting Implementation Studies
USI
Universal,selective,and indicated (prevention model)
WHO
World Health Organization.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was funded by the Ministry of Education, Culture, Sports, Science and Technology of Japan (Grants-in-Aid for Scientific Research No. 23K01813). The funder had no role in the study design, data collection, analysis, interpretation, or the decision to submit the article for publication.

Author Contribution

Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualisation, Writing – original draft, and Writing – review and editing: HO and TS.

Acknowledgement

We thank Melissa Leffler, MBA, for editing a draft of this manuscript.

Data Availability

The datasets used in this article are available from the corresponding author on reasonable request.

References

1. World Health Organization. Preventing suicide: a global imperative. 2014. https://www.who.int/publications/i/item/9789241564779. Accessed 3 Jul 2026.
2. World Health Organization. Suicide worldwide in 2021: global health estimates. 2025. https://www.who.int/publications/i/item/9789240110069. Accessed 3 Jul 2026.
3. Snowdon J, Chen YY, Zhong B, Yamauchi T. A longitudinal comparison of age patterns and rates of suicide in Hong Kong, Taiwan and Japan and two Western countries. Asian J Psychiatr. 2018;31:15–20.
4. Connors MH, Draper B, Wand APF, De Leo D, Reppermund S. Suicide and self-harm in older adults. Nat Rev Psychol. 2025;4:440–56.
5. Conwell Y, Van Orden K, Caine ED. Suicide in older adults. Psychiatr Clin North Am. 2011;34(2):451–68.
6. Gordon RS Jr. An operational classification of disease prevention. Public Health Rep. 1983;98:107–9.
7. Mrazek PJ, Haggerty RJ. Reducing risks for mental disorders: frontiers for preventive intervention research. Washington, DC: National Academy; 1994.
8. Sakashita T, Oyama H. Developing a hypothetical model for suicide progression in older adults with universal, selective, and indicated prevention strategies. Front Psychiatry. 2019;10:161.
9. Lapierre S, Erlangsen A, Waern M, De Leo D, Oyama H, Scocco P, et al. A systematic review of elderly suicide prevention programs. Crisis. 2011;32:88–98.

10. Okolie C, Dennis M, Thomas ES, John A. A systematic review of interventions to prevent suicidal behaviors and reduce suicidal ideation in older people. Int Psychogeriatr. 2017;29:1801–24.
11. Chambers DA, Glasgow RE, Stange KC. The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change. Implement Sci. 2013;8:117.
12. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci. 2009;4:50.
13. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. Milbank Q. 2004;82(4):581–629.
14. Chen J, Roth B, Dobscha SK, Lowery JC. Implementation strategies in suicide prevention: a scoping review. Implement Sci. 2024;19(1):20.
15. Krishnamoorthy S, Mathieu S, Armstrong G, et al. Utilisation and application of implementation science in complex suicide prevention interventions: a systematic review. J Affect Disord. 2023;330:57–73.
16. Sakashita T, Oyama H. Suicide prevention interventions and their linkages in multilayered approaches for older adults: a review and comparison. Front Public Health. 2022;10:842193.
17. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health. 2011;38(2):65–76.
18. Stirman SW, Kimberly J, Cook N, Calloway A, Castro F, Charns M. The sustainability of new programs and innovations: a review of the empirical literature. Implement Sci. 2012;7:17.
19. Greenberg MT, Domitrovich CE, Graczyk PA, Zins JE. The study of implementation in school-based preventive interventions: theory, research, and practice. Volume 3. Washington, DC: Substance Abuse and Mental Health Services Administration (SAMHSA); 2005.
20. Collins LM, Murphy SA, Strecher V. The Multiphase Optimization Strategy (MOST) and the Sequential Multiple Assignment Randomized Trial (SMART): new methods for more potent eHealth interventions. Am J Prev Med. 2007;32(5 Suppl):S112–8.
21. Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R. Continuity of care: a multidisciplinary review. BMJ. 2003;327(7425):1219–21.
22. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ. 2015;350:h1258.
23. Geng EH, Powell BJ, Goss CW, Lewis CC, Sales AE, Kim B. When the parts are greater than the whole: how understanding mechanisms can advance implementation research. Implement Sci. 2025;20:22.
24. Pinnock H, Barwick M, Carpenter CR, Eldridge S, Grandes G, Griffiths CJ, et al. Standards for Reporting Implementation Studies (StaRI) statement. BMJ. 2017;356:i6795.
25. Yin RK. Case study research and applications: design and methods. 6th ed. Thousand Oaks, CA: Sage; 2018.
26. Bradley EH, Curry LA, Ramanadhan S, Rowe L, Nembhard IM, Krumholz HM. Research in action: using positive deviance to improve quality of health care. Implement Sci. 2009;4:25.
27. De Leo D, Dello Buono M, Dwyer J. Suicide among the elderly: the long-term impact of a telephone support and assessment intervention in northern Italy. Br J Psychiatry. 2002;181:226–9.
28. Chan SS, Leung VPY, Tsoh J, Li SW, Yu CS, Yu GK, et al. Outcomes of a two-tiered multifaceted elderly suicide prevention program in a Hong Kong Chinese community. Am J Geriatr Psychiatry. 2011;19:185–96.
29. Oyama H, Watanabe N, Ono Y, Sakashita T, Takenoshita Y, Taguchi M, et al. Community-based suicide prevention through group activity for the elderly successfully reduced the high suicide rate for females. Psychiatry Clin Neurosci. 2005;59:337–44.
30. Sakashita T, Oyama H. Overview of community-based studies of depression screening interventions among the elderly population in Japan. Aging Ment Health. 2016;20(2):231–9.
31. De Leo D, Giannotti AV. Suicide in late life: a viewpoint. Prev Med. 2021;152:106735.
32. Liu T, Leung DKY, Lu S, Kwok WW, Sze LCY, Tse SSK, et al. Collaborative community mental health and aged care services with peer support to prevent late-life depression: study protocol for a non-randomised controlled trial. Trials. 2022;23:280.
33. Oyama H, Sakashita T. Community-based screening intervention for depression affects suicide rates among middle-aged Japanese adults. Psychol Med. 2017;47:1500–9.
34. Damschroder LJ, Reardon CM, Opra Widerquist MA, Lowery J. The updated Consolidated Framework for Implementation Research based on user feedback. Implement Sci. 2022;17:75.
35. Damschroder LJ, Reardon CM, Opra Widerquist MA, Lowery J. Conceptualizing outcomes for use with the Consolidated Framework for Implementation Research (CFIR): the CFIR Outcomes Addendum. Implement Sci. 2022;17:7.
36. Rabin BA, Cakici J, Golden CA, Estabrooks PA, Glasgow RE, Gaglio B. A citation analysis and scoping systematic review of the operationalization of the Practical, Robust Implementation and Sustainability Model (PRISM). Implement Sci. 2022;17:62.
37. Miles MB, Huberman AM, Saldaña J. Qualitative data analysis: a methods sourcebook. 4th ed. Thousand Oaks, CA: Sage; 2020.
38. Sakashita T. Building collaboration between general practitioners and social workers in community suicide prevention for middle-aged and older adults (G-Sw Network) [title translated from Japanese]. FY2025 research-status report, KAKENHI project 23K01813. Accepted May 2026; scheduled for public release November 2026. Project page: https://kaken.nii.ac.jp/ja/grant/KAKENHI-PROJECT-23K01813/. Accessed 30 September 2026.

39. Hospital Authority. HA in Focus 2005 (including the Hospital Authority 2003/04 Annual Report). Hong Kong: Hospital Authority. 2005. p. 41. https://www.ha.org.hk/ho/corpcomm/Focus/2005.pdf. Accessed 30 September 2026.
40. May C. Towards a general theory of implementation. Implement Sci. 2013;8:18.
41. Marutani M, Yamamoto-Mitani N, Kodama S. Public health nurses' activities for suicide prevention in Japan. Public Health Nurs. 2016;33(4):325–34.
42. Hawe P, Shiell A, Riley T. Complex interventions: how out of control can a randomised controlled trial be? BMJ. 2004;328(7455):1561–3.
43. Hunt CM, Spence M, McBride A. The role of boundary spanners in delivering collaborative care: a process evaluation. BMC Fam Pract. 2016;17:96.
44. World Health Organization. ExpandNet. Nine steps for developing a scaling-up strategy. Geneva: World Health Organization; 2010.
45. Breet E, Matooane M, Tomlinson M, Bantjes J. Systematic review and narrative synthesis of suicide prevention in high-schools and universities: a research agenda for evidence-based practice. BMC Public Health. 2021;21:1116.

Figures

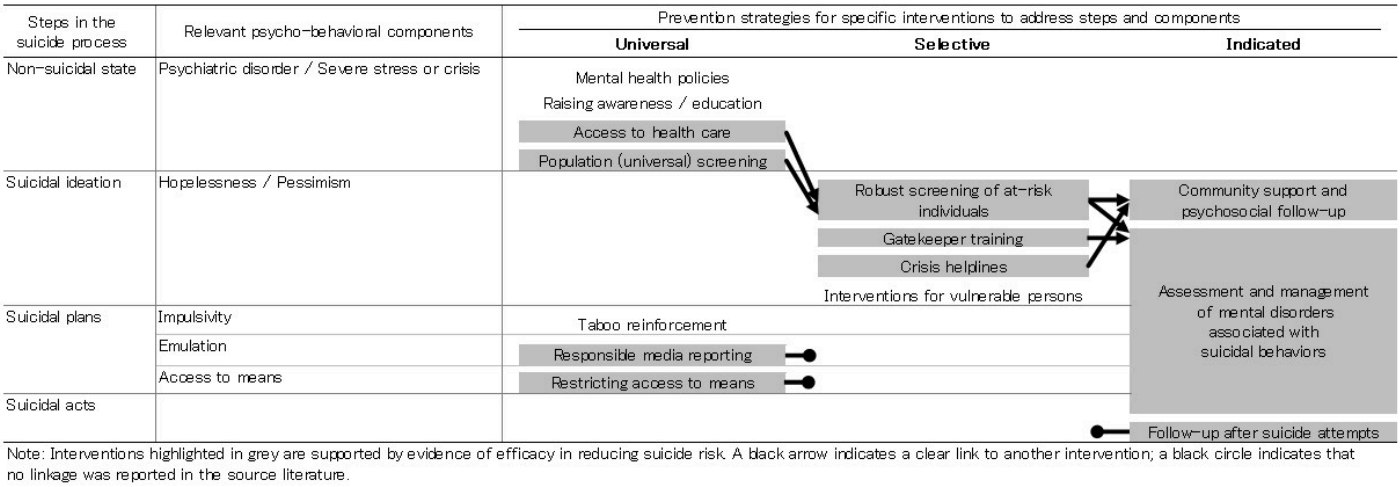

Figure 1

Schematic diagram of suicide process and prevention strategies (adapted from Sakashita and Oyama, 2019 [8]).

The diagram maps four sequential stages of suicide progression onto universal, selective, and indicated (USI) prevention strategies.

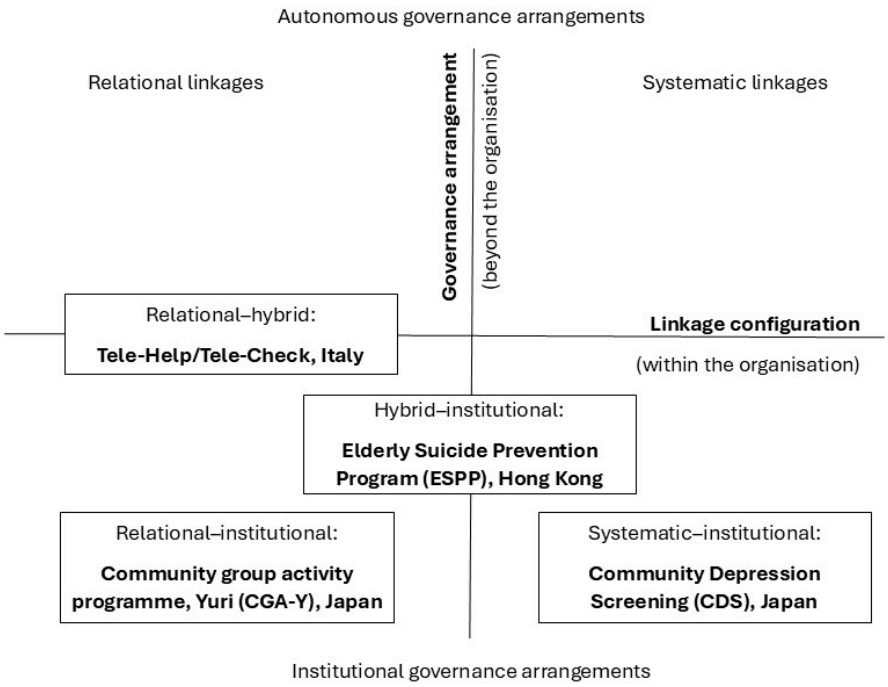

Figure 2

Analytical framework positioning programmes by linkage configuration and governance arrangement.

The framework positions the four programmes within a matrix defined by linkage configurations within organisations (relational to systematic) and governance arrangements beyond organisations (institutional to autonomous), following the distinction between inner and outer settings under the Consolidated Framework for Implementation Research (see Analytical framework subsection). Programme positions are based on the synthesis of findings in this study. Where configurations combine elements of two categories, programmes are positioned along the relevant axis to reflect hybrid arrangements.

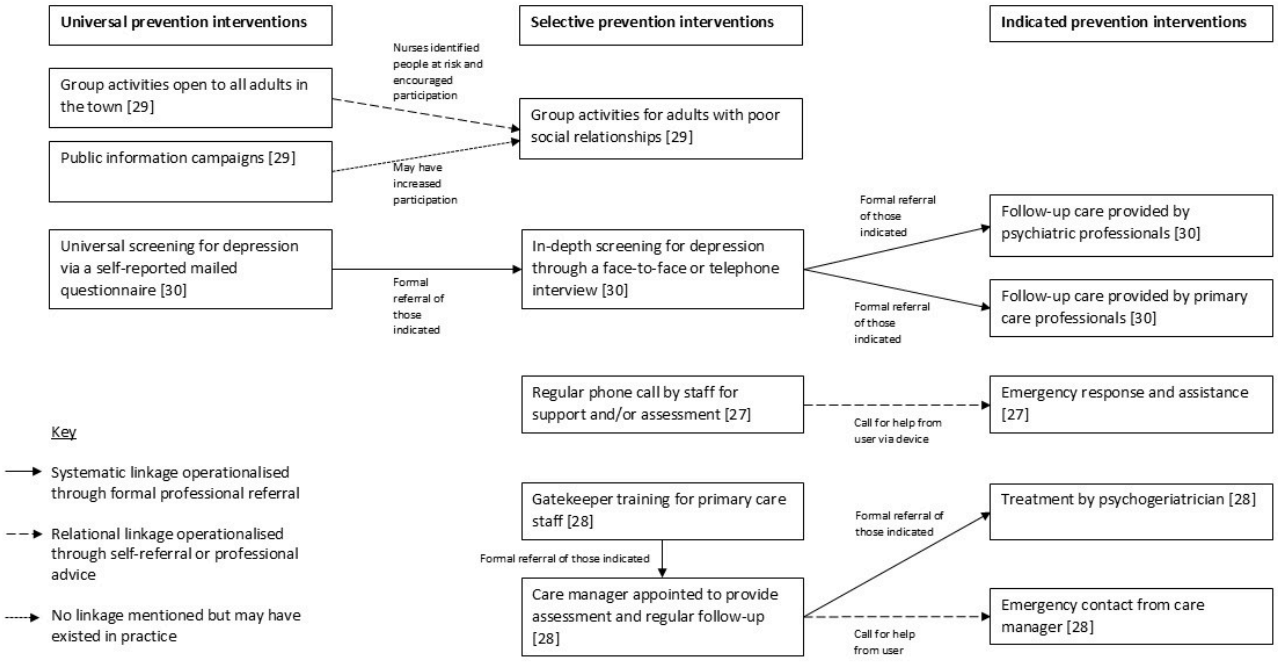

Figure 3

Linkages between prevention interventions in the four programmes (adapted from Sakashita and Oyama, 2022 [16]).

The figure shows how universal, selective, and indicated prevention components were connected within each of the four programmes. It distinguishes systematic linkage (e.g., formal professional referral), relational linkage (e.g., self-referral or professional advice), and instances in which no linkage was reported but may have existed in practice, according to the classification operationalised in the Analytical framework subsection.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.docx
- Additionalfile2.docx
- Additionalfile3.docx