Digital Innovation, Artificial Intelligence and Climate Resilience for Mental Health: Integrating Education, Socioeconomic Determinants, Climate Change and Healthy Ageing Through AI-Enabled Primary Care Mental Health Screening

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DOI: https://doi.org/10.47772/IJRISS.2026.1017PSY0064

Received: 20 September 2026; Accepted: 25 September 2026; Published: 13 October 2026

ABSTRACT

Mental disorders account for a growing share of disability in Kenya, yet specialist services remain concentrated, unequally distributed, and insufficient for population need. At the same time, educational inequality, unemployment and insecure livelihoods, food and housing stress, population ageing, and recurrent droughts, floods and heat are interacting to increase distress and reduce timely access to care. This conceptual paper examines these forces as connected determinants of mental health and proposes a Kenyan model for an artificial intelligence assisted primary care decision-support tool. The proposed tool would help Community Health Promoters and frontline clinicians conduct brief, standardized, and culturally responsive screening. This tool would help them identify common mental disorders, cognitive impairment, and climate-related psychosocial stress. It would further help them stratify urgency, provide brief education and refer people to locally available care. It would function within Kenya's existing community and primary-care architecture, including the electronic community health systems, available Primary Care Networks and county referral pathways. The model is explicitly assistive work. Diagnosis, treatment, and high-risk decisions remain with qualified practitioners. The paper describes a stepped workflow, a minimum clinical dataset, safeguards for suicide and violence risk, offline and multilingual design, and an implementation pathway from co-design through pragmatic evaluation. It argues that responsible AI can strengthen task-sharing and continuity only when accompanied by service capacity, human supervision, data protection, algorithmic monitoring, disability and age inclusion, and climate-responsive planning. Kenya's recent primary-care, digital-health, and AI policy reforms create an important opportunity. That said, technology should be evaluated by whether it improves equitable access and safe action rather than by technical performance alone.

Keywords: artificial intelligence, primary health care, mental health screening, climate resilience, healthy ageing.

INTRODUCTION

Kenya is confronting a mental-health challenge whose causes and consequences extend well beyond the clinic. Psychological distress is produced and sustained through family and community relationships, schooling, work, income, food security, housing, disability, chronic illness and exposure to environmental shocks. The same conditions also determine whether a person can recognize a problem, disclose it, travel to a facility, pay for care, adhere to treatment, and recover. A drought-related loss of livestock, for example, may simultaneously remove income, weaken social status, disrupt nutrition, increase household conflict and produce symptoms of anxiety, depression or harmful alcohol use. In an older person, the effects may be compounded by frailty, hypertension, diabetes, bereavement, sensory impairment, and reduced mobility.

The conventional response - waiting for people to present to a specialist psychiatric service - cannot match this pattern of need. Kenya's policy direction instead supports integration of mental health into primary and community care. The Kenya Mental Health Policy 2015–2030 frames mental health as a right and a development priority. National clinical guidance and mhGAP-oriented trainings currently on-going in a number of Counties in the Country support non-specialist care. The Primary Health Care Act and Digital Health Act of 2023 provide a contemporary legal and organizational platform for integrated, data-enabled delivery. More than 107,000 Community Health Promoters have been deployed, many with digital tools, while Primary Care Networks are intended to link community units and lower-level facilities to referral hospitals (Ministry of Health Kenya, 2024a, 2024b).

This paper asks a practical question: How can Kenya use that emerging infrastructure to identify distress earlier and connect people to appropriate help without automating clinical judgement, reproducing inequity, or creating a new source of harm? It proposes an AI-assisted decision-support system whose purpose is not diagnosis by machine, but consistent screening, contextual interpretation, risk recognition, brief education, and referral support. The argument is that education, socioeconomic determinants, climate resilience and healthy ageing should be represented within one workflow because they converge in the same person and shape the same care pathway.

Approach and Scope

This is a conceptual and policy paper rather than a report of primary empirical research. It synthesizes Kenyan health, digital, data-protection and climate policy with international evidence on social determinants, healthy ageing, task-sharing, digital mental health and ethical AI. The proposed model is therefore a testable design hypothesis. Its effectiveness, safety, acceptability, and cost-effectiveness would need prospective evaluation before national deployment. The intended setting is Kenyan community and primary care, particularly community units and Level 2 and Level 3 facilities linked through Primary Care Networks, with escalation to Levels 4, 5, and 6 as well as emergency services as clinically indicated.

The Contemporary Kenyan Mental Health Challenge

Need Exceeds Specialist Capacity

Globally, almost one billion people were living with a mental disorder in 2019, and mental disorders account for about one in six years lived with disability (World Health Organization, 2022a). Kenya's Mental Health Investment Case describes a large gap between need and available care and makes the economic case for scaling evidence-based interventions (Ministry of Health Kenya & World Health Organization, 2021). In 2024, the Ministry of Health linked new national clinical guidelines and mhGAP e-training to an estimated 75% treatment gap (Ministry of Health Kenya, 2024c). The exact burden varies by population and instrument, but the direction is clear. The most need is encountered outside specialist psychiatry, frequently first appearing as sleep disturbance, pain, fatigue, poor adherence, substance use, family conflict, school difficulty or repeated attendance for physical symptoms. Devolution creates both opportunity and variation. Counties control much frontline service delivery, but differ in workforce, budgets, referral distances, medicine availability, and partnerships. A national digital tool cannot assume that the same referral option exists everywhere. It must therefore use a maintained county service directory and distinguish what should happen clinically from what is locally feasible, while making service gaps visible to planners rather than disguising them as completed referrals.

Education and Mental Health Literacy

Education influences mental health through several routes. Years of schooling and learning-quality affect employment, income, health literacy, and perceived control. Within schools and training institutions, violence, examination pressure, exclusion, disability-related barriers, and uncertain transitions into work can contribute to distress. Mental health literacy; the ability to recognize symptoms, understand possible causes, know what forms of help exist and act without stigma, affects whether distress becomes a disclosed and treatable concern.

Education must therefore be built into the proposed tool in two senses. First, the tool should communicate in plain English and Kiswahili, with carefully co-designed support for additional Kenyan languages, low literacy, visual or audio formats, and disability access. Second, every screening encounter should yield a brief explanation. In other words, what the result means, what it does not mean, what can be tried now, when to seek urgent help, and where help is available. Screening without comprehension risks labelling; education turns measurement into agency.

Socioeconomic Determinants and the Risk of Medicalizing Hardship

Poverty, unemployment, debt, food insecurity, insecure housing, violence, and lack of transport increase exposure to distress and constrain recovery. These are not merely "background variables." They can determine symptom onset, severity, adherence, and risk. Yet a screening system can cause harm if it converts understandable suffering into a disorder while ignoring the conditions producing it. The solution is neither to withhold clinical care nor to diagnose poverty. It is to assess symptoms and functioning alongside material and relational stressors, then offer parallel pathways that include clinical care where indicated and social, legal, protection, or livelihood support where relevant. For Kenyan primary care this means asking a small number of actionable questions about food, housing, safety, caregiving, income disruption, disability, transport, and social support. The purpose is not exhaustive social surveillance. Each question should justify its inclusion through a realistic response option. If no response exists, aggregated de-identified data may still support planning, but the patient should not be led to expect assistance that cannot be provided.

Climate Change as A Mental Health Systems Issue

Kenya's arid and semi-arid lands face recurrent drought, while floods, heat, crop losses, water insecurity, displacement, and vector-borne disease affect multiple regions. The mental-health pathways are direct and indirect. Direct exposure to injury, bereavement, displacement and disaster can produce acute stress, depression, anxiety and post-traumatic symptoms. Indirect pathways operate through livelihood loss, food-price shocks, migration, conflict over resources, interrupted schooling, gendered caregiving burdens and disruption of medication and clinical services. Emerging Kenyan studies in Kilifi and climate-affected regions describe local idioms of ecological distress and links between extreme weather, resource insecurity, and mental health (Bosire et al., 2025; Kagunda et al., 2025).

Climate resilience in mental healthcare therefore means more than counselling after a disaster. It requires continuity plans for medicines and records, psychological first aid, protection and referral protocols, mobile or remote follow-up, surge capacity, support for responders, and anticipatory targeting of high-risk households. An AI-assisted system could flag climate exposure and service interruption, but its greatest value may be at population level. This would be in helping counties see clusters of distress and unmet need after a flood or prolonged drought. Such surveillance must use minimum necessary, de-identified data and must never be used to deny services, police mobility or stigmatize communities.

Healthy Ageing and Life-Course Continuity

Kenya remains a youthful country but is ageing in absolute numbers. Longer survival with HIV and non-communicable diseases means that more older adults live with multimorbidity, polypharmacy, sensory impairment, frailty, cognitive change, and caregiving dependence. Depression may present as bodily complaints or memory concerns. Delirium may be mistaken for dementia. While social isolation or elder abuse may remain hidden. Evidence from Kenya and the region suggests substantial burdens of depression and cognitive impairment in older populations, including older adults living with HIV (Mwangala et al., 2021).

Healthy ageing is a life-course and systems concern. The proposed tool should therefore avoid a separate "elderly module" that appears only after a crisis. Age-sensitive prompts should assess mood, cognition, functioning, medication effects, falls, sleep, pain, alcohol use, bereavement, loneliness, neglect, and caregiver strain. Brief cognitive screening must be interpreted with attention to education, language, sensory

capacity, and acute illness. A positive screen is not a dementia diagnosis. It is a reason for clinical assessment, collateral history, and reversible-cause evaluation.

Why AI and Why Now

Kenya's recent reforms create a plausible implementation window. The Primary Health Care Act formalizes community health units and Primary Care Networks. The Digital Health Act establishes governance for digital health, interoperability, and health-data use. Community Health Promoters have been equipped for household-level digital work, and the Ministry reports continuing expansion of digitized services and facility connectivity (Ministry of Health Kenya, 2025, 2026). Kenya's Artificial Intelligence Strategy 2025-2030 and the 2026 policy on AI and emerging technologies further signal a national interest in responsible, locally relevant AI (Ministry of ICT and the Digital Economy, 2025, 2026).

AI can add value where the problem is not a lack of questionnaires but difficulty selecting, administering, interpreting, and acting on them consistently. A rules-based layer can score validated instruments and enforce safety actions. A carefully constrained language layer can translate everyday descriptions into structured prompts, provide low-literacy explanations, and generate a concise clinician summary. A service-matching layer can identify the nearest currently available referral option. Analytics can show where referrals fail and where climate-related needs are rising. None of these functions requires the system to make an autonomous psychiatric diagnosis. The case for AI is therefore conditional. If the referral directory is stale, if the clinician cannot see how a recommendation was produced, if connectivity excludes rural users, or if facilities lack capacity to receive referrals, the tool will digitize dysfunction. The design objective must be better decisions and completed care pathways, not maximum automation.

Proposed AI Enabled Primary Care Model

Design Principles

The tool is designed to assist rather than replace professional judgement. It supports structured assessment and decision-making, while qualified clinicians retain responsibility for diagnosis, treatment, and escalation. Access begins through a single-entry point involving a brief assessment of distress, functioning and safety, followed by focused modules of greater depth only when indicated. Classification is grounded in context, with symptoms interpreted alongside physical illness, medication use, substance use, disability, social adversity, and climate-related exposure. Every question, score, and alert must produce an actionable outcome, including education, reassessment, brief intervention, protection, referral, or emergency action. The tool should adopt an offline-first, multilingual design, with core functions remaining accessible during intermittent connectivity and spoken or visual interaction available for users with literacy- or disability-related needs. Equity must be embedded in its design and evaluation by assessing performance across age, sex, disability, language, county, urban or rural residence, and socioeconomic position. Human accountability must remain central: users should be informed whenever AI is involved, be able to correct their information and have access to human review.

Encounter Workflow

The proposed encounter workflow is presented on Table 1

Table 1. Proposed encounter workflow for AI-assisted screening in Kenyan primary care.

Step	Function	Illustrative content	Output and action
1	Consent and access	Identity, preferred language and mode, accessibility needs, privacy explanation	Consent recorded; alternative non-digital route offered
2	Rapid check	Current concern, distress, functioning, acute confusion, self-harm, violence, or	Immediate emergency pathway when red

		severe behavioral disturbance	flags are present
3	Focused screening	Validated short instruments selected by age and presentation; physical and substance-use differentials	Scores plus plain-language interpretation; no autonomous diagnosis
4	Context screen	Food, housing, safety, caregiving, disability, livelihood disruption, displacement, and climate exposure	Clinical and social needs represented side by side
5	Risk formulation	Symptoms, intent, means, history, protective factors, cognition and safeguarding	Low, moderate, high or emergency urgency with required human review
6	Decision support	National guidance, medicines and comorbidities, brief psychosocial actions	Suggested next steps with reasons, contraindication prompts and uncertainty
7	Referral and follow-up	County directory, service level, distance, cost, accessibility and availability	Warm referral, safety plan, follow-up date, and failed-referral tracking
8	Learning system	De-identified outcomes, overrides, adverse events, and equity indicators	Local quality improvement and controlled model updating

Screening Content

The core screen should be short enough for routine use and modular enough to avoid indiscriminate questionnaire burden. A two-stage design is preferable. Stage one asks about the presenting concern, emotional distress, functional change, and immediate safety. Stage two uses focused modules when triggered. Depending on age and context, these may include PHQ-2 followed by PHQ-9 for depression, GAD-2 followed by GAD-7 for anxiety, AUDIT-C for alcohol, a brief substance-use screen, WHO-5 for wellbeing, PCL-5 for trauma screening, and a brief cognitive and functional assessment. Instruments require licensing review, validated translations and locally tested thresholds. Scores should inform rather than determine care.

Question 9 of the PHQ-9 illustrates why deterministic scoring is insufficient. Any non-zero response should trigger direct assessment of current thoughts, intent, plan, access to means, past behavior, acute intoxication or psychosis, protective factors, and the safety of the environment. The response must depend on clinical formulation, not the total depression score. The system should require acknowledgement of the alert, document the action taken, and prevent silent closure of a high-risk encounter.

Climate and Socioeconomic Module

A concise context module could ask whether recent drought, flood, heat, crop or livestock loss, displacement, food shortage, or loss of income has affected the household. It should further ask whether treatment or travel has been interrupted and also whether there is conflict, exploitation, or safety concern. Responses would generate practical options such as psychological first aid, social-protection referral, nutrition services, gender-based violence pathways, chronic-disease continuity planning, or county disaster support. The tool should record “service unavailable” and “person declined” separately from “referral completed.” This distinction is essential for honest system learning.

Referral Architecture

Referral should follow a stepped-care map. Mild distress without major functional impairment may receive psychoeducation, sleep and activity guidance, problem-solving support, and planned review. Persistent or moderate symptoms may be managed by a trained primary-care clinician using national guidance, with

counselling or teleconsultation where available. Severe symptoms, suspected bipolar disorder or psychosis, cognitive decline with risk, complex substance use, perinatal risk, or diagnostic uncertainty require specialist input. Imminent self-harm, violence, severe withdrawal, delirium, catatonia, or inability to care for basic needs requires same-day emergency action. Each recommendation should display its basis and allow a clinician to override it with a documented reason.

A Conceptual Framework for Integrated Action

The proposed model can be understood as a chain from determinants to action. Structural conditions; education, income, gender, disability, age and climate exposure, shape stress and protective resources. These influence symptoms, functioning, physical illness, and help-seeking. Community and primary-care encounters provide an opportunity for recognition. The AI tool standardizes questions, supports interpretation and connects findings to a locally feasible response. Outcomes depend on both decision quality and service availability. Follow-up then feeds back into individual care and system planning.

This formulation prevents two common errors. The first is technological reductionism: assuming that prediction is equivalent to care. The second is clinical reductionism: treating symptoms without attending to the material and environmental conditions that maintain them. The tool sits in the middle of a human and institutional pathway. It cannot substitute for either.

Ethical Legal and Governance Requirements

Data Protection and Consent

Mental-health, disability, location, and socioeconomic data are highly sensitive. Kenya's Data Protection Act 2019 and its regulations require lawful, fair and transparent processing, purpose limitation, data minimization, accuracy, security, and respect for data-subject rights. The Digital Health Act adds sector-specific duties concerning health information and health data banks. Deployment should therefore begin with a data-protection impact assessment, clear allocation of controller and processor roles, role-based access, encryption, audit logs, retention limits, breach response, and controls on cross-border processing. Consent should be understandable and should not be bundled with access to ordinary care.

The tool should collect the least information needed for care. Free-text conversations should not automatically become training data. Secondary use for model improvement or research requires a separate lawful basis, governance approval and, where appropriate, consent. Individuals should be able to correct errors and request human review. Children, persons with cognitive impairment, and people in coercive or dependent relationships require additional safeguards for assent, consent, and confidentiality.

Bias Validity and Explainability

Models trained mainly on North American or European English may misunderstand Kenyan idioms, code-switching, indirect disclosure, and culturally shaped expressions of distress. Performance may also differ by education, age, disability, accent, county, or device type. Local adaptation must include participatory corpus development, expert annotation, prospective validation, and subgroup analysis. Kiswahili is essential but sometimes insufficient. Kenya's linguistic diversity and the practical use of Sheng and mixed-language speech require careful testing rather than informal machine translation.

Explainability should be operational. A frontline worker should see which answers and rules produced an alert, what uncertainty remains, and which action is required. The patient should receive an accessible explanation without technical labels. The county or national authority should be able to audit model versions, changes, false-negative events, clinician overrides, and subgroup performance. WHO's ethical principles; autonomy, well-being and safety, transparency, responsibility, inclusiveness, and sustainability, offer an appropriate high-level frame (World Health Organization, 2021).

Safety Boundaries

The tool must not autonomously make diagnoses, prescribe treatment, determine involuntary care, or make discharge decisions. It must avoid unsupported reassurance whenever concerns relating to self-harm, violence, psychosis, delirium, or safeguarding are identified. A rules-based safety layer, which cannot be overridden by generative output, should govern responses to these high-risk presentations. The tool must also communicate uncertainty clearly and require escalation whenever available information is incomplete, ambiguous, or internally inconsistent. Routine adverse-event reviews should be conducted, with accessible mechanisms through which frontline users and patients can report harmful, inaccurate, or inappropriate outputs. In addition, a clearly defined downtime procedure must ensure safe continuity of assessment, documentation, referral, and escalation whenever the device, network, service directory, or model is unavailable.

Implementation Roadmap for Kenya

The proposed development and evaluation pathway are presented on Table 2

Table 2. Proposed Phased Development and Evaluation Pathway.

Phase	Main activities	Setting and sample	Decision gate
Co-design	Map workflows; interview service users, caregivers, CHPs, clinicians, county managers, older persons and persons with disabilities; develop language and safety requirements.	Contrasting rural, urban, ASAL and flood-prone counties.	Acceptable use cases and explicit exclusions.
Prototype	Build offline-first rules, modular screens, explanations and service directory; conduct usability and simulated-risk testing.	Laboratory and supervised facility testing.	No critical safety defects; usable across literacy and disability groups.
Prospective validation	Compare tool-supported screening and risk flags with blinded clinical assessment; evaluate subgroup performance.	Multiple counties and levels 1–4.	Pre-specified sensitivity, calibration and fairness thresholds.
Pragmatic pilot	Cluster or stepped-wedge evaluation of workflow, completed referrals, outcomes, workload, acceptability and costs.	Primary Care Networks with receiving services strengthened first.	Evidence of net clinical benefit without widening inequity.
Controlled scale	County rollout, procurement standards, training, audit dashboards, incident reporting and independent review.	Phased national expansion.	Sustained outcomes, governance capacity and affordable total cost.

Co-design and County Selection

A useful pilot should represent Kenya's diversity rather than begin only in a well-connected Nairobi facility. County selection should include an urban informal-settlement context, an agrarian county exposed to flood or crop loss, an arid or semi-arid pastoral setting, and a county with established mental-health integration that can test referral completion. Co-design participants should include adolescents and young adults, older people, caregivers, people with psychosocial and other disabilities, CHPs, nurses, clinical officers, medical

officers, psychologists, psychiatrists, social workers, traditional and faith actors where appropriate, emergency personnel, and county planners.

Workforce Preparation

Technology changes work. Training should cover supportive communication, informed consent, use of the screens, direct suicide enquiry, safeguarding, psychological first aid, brief problem-solving, cognitive red flags, referral procedures, documentation, and downtime practice. Supervision is essential. CHPs should not be made responsible for specialist decisions or exposed to unmanageable caseloads. The tool should reduce cognitive burden and support escalation, not transfer institutional risk onto the least powerful worker.

Evaluation Outcomes

Technical accuracy is necessary but not sufficient. The primary evaluation question is whether tool-supported care improves safe recognition and completed action. Outcomes should include screening reach, time per encounter, agreement with clinical assessment, false-negative high-risk events, referral completion, symptom and functional change, patient understanding, acceptability, clinician workload, continuity after climate disruptions, equity gaps, adverse events, and cost per additional person appropriately managed. Implementation outcomes should include feasibility, fidelity, adoption, sustainability, and directory accuracy. Qualitative work should examine trust, stigma, unintended disclosure, changes in professional roles, and how people interpret AI involvement.

DISCUSSION

The Kenyan opportunity is unusually concrete. The country has a devolved health system, a large community-health workforce, growing digital infrastructure, a legal basis for digital health, and a national policy interest in AI. These assets can support earlier mental-health recognition at household and primary-care level. They also create a temptation to scale rapidly. Mental health requires particular caution because language is the clinical material, risk can change quickly, and errors can affect liberty, employment, family relationships, and life itself.

The proposed model offers four contributions. First, it places social and climate determinants inside, not beside the clinical workflow. Second, it connects screening to a real stepped referral pathway and records whether care is actually received. Third, it includes healthy ageing and cognitive concerns within general primary care rather than treating them as a future specialist problem. Fourth, it defines AI as a layered decision aid, providing validated instruments and explicit rules for scoring and safety, constrained language support for communication and summarization, as well as local service matching for action.

Several limitations must be acknowledged. Screening can increase demand faster than counties can respond. Referral directories decay. Self-report instruments can perform differently across languages and groups. Generative systems may fabricate, oversimplify, or reproduce bias. Digital exclusion may be greatest among the people with the highest need, including older adults, remote communities, and people with disability. Finally, climatic and socioeconomic distress cannot be solved by a health application. These are reasons for a phased, service-linked implementation, but not for abandoning innovation.

Financing should include the full pathway: starting from devices through to connectivity, maintenance, training, supervision, referral capacity, cybersecurity, independent evaluation, and periodic revalidation. A cheap application connected to an unfunded service is not cost-effective. Procurement should require data portability, interoperability, transparent model documentation, exit provisions, local capacity transfer, and protection against vendor lock-in. Public value should remain the governing criterion.

POLICY AND PRACTICE RECOMMENDATIONS

The tool should be embedded within Ministry of Health clinical guidance, county Primary Care Networks and eCHIS-compatible workflows rather than implemented as a parallel platform. Its governance should be

entrusted to a national multidisciplinary oversight group comprising service users, representatives of persons with disabilities and older persons, county governments, clinicians, data-protection experts, and climate-health actors. Initial implementation should be restricted to clearly defined support functions, including screening, risk prompting, education, summarization and referral, while autonomous diagnosis and prescribing remain prohibited. A comprehensive county-level service directory covering clinical, psychosocial, protection, disability, ageing, and climate-response services should be developed and continuously verified to support appropriate referrals.

The tool should support offline operation, accessible design, Kiswahili and locally validated language pathways, alongside an equivalent-quality non-digital route. Its rollout must be linked to strengthened receiving services, routine clinical supervision and explicit protocols for suicide risk, violence, safeguarding concerns, and cognitive emergencies. Prospective validation findings and subgroup performance should be published, while false-negative results and adverse events are continuously monitored. Deployment should be paused whenever predetermined safety thresholds are not met. De-identified aggregate data may be used to inform climate preparedness and resource allocation, provided that punitive, commercial, or discriminatory secondary uses are explicitly prohibited. Ultimately, the tool's public value should be evaluated through completed care pathways, functional improvement, equity, and system resilience rather than the number of screenings, downloads, or algorithm-generated outputs.

CONCLUSION

Kenya does not need an AI system that merely identifies more distress. It needs a stronger pathway from recognition to understandable, safe, and locally available care. Education, socioeconomic conditions, climate exposure, and ageing are interdependent parts of that pathway. When they are incorporated into a brief, culturally responsive, and clinically governed primary-care workflow, AI can help frontline workers ask consistently, recognize risk, explain findings, and navigate services. Its proper role is augmentation: making good public-health and clinical practice easier to deliver, audit, and improve.

The decisive question is not whether AI can produce a mental-health score. It is whether a person - young or old, urban or rural, disabled or not, climate-affected, or economically secure - becomes more likely to receive timely, dignified, and effective help. A phased Kenyan program built on co-design, human oversight, legal compliance, service strengthening, and transparent evaluation offers a credible route to answering that question.

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