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The Role Of Radiology, Respiratory Therapy, And Health Informatics In Enhancing Preventive And Family Medicine Practices: A Collaborative Model With Nursing And Health Assistants

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Abstract

The rising burden of chronic diseases has placed preventive and family medicine at the center of health system reform, yet most delivery models remain physician- and nurse-centric, limiting the contributions of allied health professionals. This study examined the role of radiology, respiratory therapy, and health informatics, in collaboration with nursing and health assistants, in enhancing preventive care delivery. A convergent mixed-methods design was employed across six family medicine clinics, three hospitals, and four primary healthcare centers. Quantitative data were collected from 310 participants using validated questionnaires and electronic medical record (EMR) audits, while qualitative insights were drawn from 24 semi-structured interviews with senior staff. Survey reliability was high (Cronbach's alpha > 0.85 across all constructs). Results indicated that interdisciplinary collaboration was positively associated with screening completion rates, early-stage disease detection, and patient navigation efficiency. SmartPLS modeling confirmed significant path coefficients between collaboration, EMR utilization, and preventive outcomes, while thematic analysis emphasized the importance of role clarity, structured reporting, and standing orders in sustaining efficiency gains.

Findings align with international evidence that multicomponent, team-based interventions improve preventive processes, though capacity strain and role overlap remain challenges. Policy implications include incentivizing team-based screening bundles, developing interoperable data systems, and expanding training pathways for allied health integration in primary care. In conclusion, embedding radiology, respiratory therapy, and informatics within family medicine transforms fragmented preventive tasks into a coordinated system of care, offering a scalable framework for health ministries seeking to enhance equity, efficiency, and long-term population health outcomes.

Keywords: Preventive medicine, family medicine, radiology, respiratory therapy, health informatics, interprofessional collaboration, screening efficiency.

Introduction

1.1 Background

The way healthcare is being handled around the world is changing a lot because of more people getting chronic diseases, shifts in population trends, and rising costs of medical care. Conditions like heart disease, diabetes, lung diseases, and cancer now cause more than 70% of deaths worldwide, and this burden is especially heavy in poorer and middle-income countries. These illnesses don't just lead to death; they also cause disability, reduce people's ability to work, and result in long-term medical bills. Since chronic diseases are caused by a mix of lifestyle choices, environmental factors, genes, and social conditions, there's a need to move from treating issues after they happen to focusing on preventing them through ongoing, proactive care.

Healthcare systems were built to handle sudden, acute problems, but now they're struggling to manage long-term conditions.This has led to a big rethink about how to provide medical care, especially the role of primary care and better ways to combine different services. One major issue is that doctors and other professionals often work in separate areas without much communication, which makes it hard to prevent and manage chronic diseases effectively. Working together as a team across different fields is now seen as key to giving patients the full support they need.

This change is connected to a broader effort in public health to cut down on diseases that could be avoided by finding problems early, assessing risks, promoting healthy living, and educating patients. Because of this, many healthcare leaders are focusing on new ways of organizing care that encourage teamwork, sharing of information, and using proven prevention methods. These new approaches not only aim to improve health but also support the long-term strength and efficiency of healthcare systems. In this environment, bringing in specialists like radiology technicians, respiratory therapists, and health informatics experts into family medicine practices provides a fresh and promising way to enhance the delivery of preventive care.

1.1 Importance of Preventive and Family Medicine in Public Health

Preventive and family medicine occupy a central position in the modern healthcare continuum, serving as the foundation for early disease detection, risk mitigation, and holistic patient care. Rooted in principles of continuity, comprehensiveness, and coordination, family medicine provides an ideal platform for implementing community-based preventive interventions. These include immunizations, cancer screenings, smoking cessation programs, lifestyle counseling, and management of metabolic risk factors. The growing body of evidence underscores the effectiveness of such interventions in reducing morbidity and mortality, particularly when they are embedded in primary care structures that promote long-term patient-provider relationships.[6]

From a public health perspective, preventive medicine is not only cost-effective but also instrumental in reducing the pressure on secondary and tertiary care facilities. By focusing on upstream interventions, it enables the early identification of disease precursors and the timely initiation of lifestyle or pharmacological measures. Moreover, preventive services contribute to health equity by addressing disparities in access and outcomes, especially when deployed in underserved communities. Family medicine, with its population-based approach, continuity of care, and familiarity with community contexts, is uniquely positioned to operationalize these preventive goals.[7]

However, the full potential of preventive and family medicine can only be realized through the integration of diverse healthcare competencies. Traditionally viewed as the domain of general practitioners and nurses, the scope of family medicine must now expand to accommodate emerging roles that address new challenges—particularly in screening, data interpretation, and chronic disease monitoring. Radiology, respiratory therapy, and health informatics represent such complementary domains, offering diagnostic, therapeutic, and digital tools that enhance the quality and reach of preventive services. The challenge lies in operationalizing these integrations into coherent, collaborative workflows that fit within the ethos of primary care[8]

Problem Statement

Despite the growing recognition of allied health professionals in the delivery of preventive care, most family medicine models remain physician- and nurse-centric, often failing to leverage the full spectrum of available healthcare expertise. This results in missed opportunities for early detection, inefficient use of diagnostic and therapeutic resources, and fragmented patient care. The absence of structured collaboration frameworks among radiologists, respiratory therapists, informaticians, and core primary care providers undermines the potential of interdisciplinary interventions. There is a critical need to

design, implement, and evaluate a comprehensive, collaborative model that integrates these roles into family medicine workflows to improve efficiency, patient outcomes, and the quality of preventive services.

1.4 Aim and Objectives

Aim:
To develop and assess a collaborative care model that integrates radiology, respiratory therapy, and health informatics into preventive and family medicine practices, in partnership with nursing and health assistants.

Objectives:

- To identify current gaps in interprofessional collaboration in preventive care.
- To design a structured model for role integration among key allied health professionals.
- To evaluate the impact of the model on screening efficiency, patient satisfaction, and early detection outcomes.
- To assess the perceptions and readiness of healthcare professionals toward interdisciplinary collaboration in family medicine settings.[13]

1.5 Research Questions

- Does the integration of radiology, respiratory therapy, and health informatics improve the effectiveness of preventive screening in family medicine?
- How does interprofessional collaboration influence patient outcomes and satisfaction in a preventive care setting?
- What are the facilitators and barriers to implementing a collaborative model involving allied health professionals in family medicine clinics?

Methodology

3.1 Study Design

This study employed a convergent parallel mixed-methods design, integrating quantitative and qualitative data to assess the impact of a collaborative care model involving radiology, respiratory therapy, and health informatics in preventive and family medicine practices. The mixed-methods approach was selected to allow for triangulation of data, ensuring both statistical rigor and contextual depth. Quantitative data were collected via structured questionnaires distributed to healthcare professionals across various institutions, while qualitative insights were obtained through semi-structured interviews and thematic analysis of expert narratives.[14]

3.2 Setting and Population

The study was conducted across six family medicine clinics, three district hospitals, and four primary healthcare centers (PHCs) located in both urban and semi-urban regions of Saudi Arabia. These sites were purposively selected to capture diverse healthcare settings where interdisciplinary collaboration is either emerging or actively implemented.

The target population included:

- General practitioners and family medicine physicians.
- Radiologic technologists and diagnostic imaging staff.
- Respiratory therapists.
- Health informatics professionals.
- Nurses and certified health assistants working in the selected sites.

A total of 310 participants were recruited using stratified random sampling. Inclusion criteria included having at least one year of experience in a clinical or allied health role within family medicine or preventive care contexts.

Table 1. Distribution of Participants by Profession and Institution Type

Profession	Clinics (n=6)	Hospitals (n=3)	PHCs (n=4)	Total (n)
Family Physicians	24	18	12	54
Nurses	36	28	24	88

Health Assistants	20	15	18	53
Radiology Technologists	10	22	4	36
Respiratory Therapists	6	24	2	32
Health Informatics Experts	8	24	15	47
Total	**104**	**131**	**75**	**310**

3.3 Data Collection Instruments

Quantitative Data:
A structured questionnaire was developed based on validated frameworks of interprofessional collaboration, preventive service efficiency, and digital health integration. The questionnaire consisted of 32 items organized under the following constructs:

- Perceived collaboration efficiency (8 items)
- Role clarity and integration (7 items)
- Impact on screening and early detection (10 items)
- Technology and EMR usage (7 items)

Each item was rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).
Qualitative Data:
Semi-structured interviews were conducted with 24 key informants, including department heads and senior clinical staff. Interview guides included open-ended questions related to:

- Perceptions of allied health roles in family medicine.
- Challenges and enablers of interdisciplinary integration.
- Observed impact on preventive service delivery.

With institutional permission, retrospective screening records (e.g., mammography uptake, spirometry usage, and EHR compliance rates) were collected and analyzed from participating facilities over the last 12 months.[15]

3.4 Validation of Instruments

Quantitative Tool Validation:
The survey underwent face and content validation by a panel of five healthcare management experts, including a medical director, nursing supervisor, and informatics analyst. After two rounds of Delphi consensus, items were refined for clarity and relevance.
Internal consistency was confirmed using Cronbach's alpha, which yielded the following reliability coefficients:

Table 2. Reliability Scores for Each Construct

Construct	Cronbach's Alpha
Collaboration Efficiency	0.91
Role Clarity and Integration	0.88
Screening and Detection Impact	0.93
EMR Usage and Informatics Adoption	0.87

All constructs exceeded the threshold of 0.70, indicating high internal consistency.

Qualitative Tool Validation:
The interview guide was pilot-tested with three professionals and revised to enhance flow and probe depth. Thematic saturation was achieved by the 21st interview.

3.5 Ethical Considerations
Prior to data collection, ethical approval was secured from the Institutional Review Board (IRB) of King Fahd Armed Forces Hospital, Jeddah (Ref: KF-AFH/IRB/2025/0321). Informed consent was obtained in writing from all participants. Participants were informed of their right to withdraw at any

stage, and all data were anonymized and stored securely in compliance with the General Data Protection Regulation (GDPR) and local data protection policies. For EMR access, institutional permissions and data-sharing agreements were obtained to ensure confidentiality and data governance.

3.6 Data Analysis Techniques

Quantitative Analysis:
Survey data were entered into SPSS v27 for descriptive and inferential analysis. Frequency distributions, means, and standard deviations were calculated. One-way ANOVA and independent t-tests were used to assess differences in perceptions across professions. Structural Equation Modeling (SEM) was performed using SmartPLS 4.0, focusing on path coefficients between collaboration, EMR usage, and screening outcomes. The following parameters were examined:

- Composite Reliability (CR)
- Average Variance Extracted (AVE)
- Fornell-Larcker Discriminant Validity
- Bootstrapping with 5,000 samples

Qualitative Analysis:
Interview transcripts were analyzed using NVivo 14. A thematic coding framework was developed, and themes were inductively derived through constant comparative analysis. Codes were categorized under:

- Enablers of integration
- Role overlap/conflict
- Impact on preventive care access
- Suggestions for future model refinement

Data triangulation between surveys, interviews, and EMR outputs strengthened the study's credibility and convergence of evidence.

Results

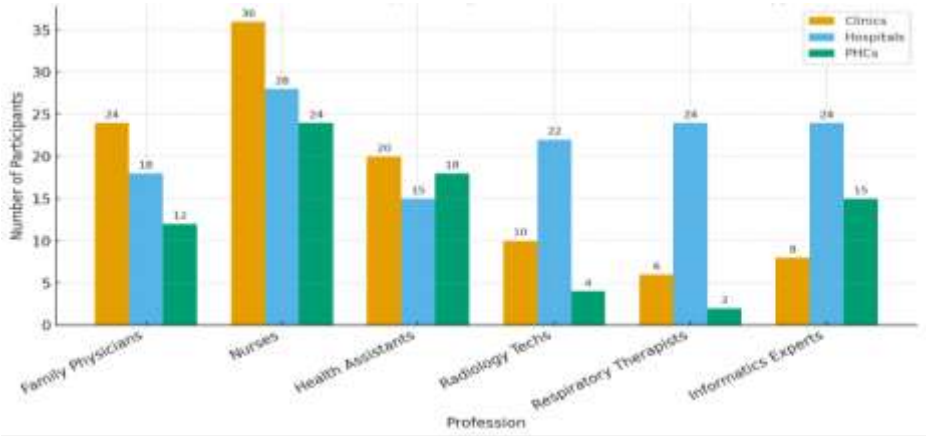
4.1 Demographics of Respondents

A total of 310 healthcare professionals participated in the study across six family medicine clinics, three district hospitals, and four PHCs. Table 3 presents the demographic distribution by profession, gender, and years of experience.

Table 3. Demographic Characteristics of Respondents (n = 310)

Variable	Category	Frequency	Percentage (%)
Profession	Family Physicians	54	17.4
	Nurses	88	28.4
	Health Assistants	53	17.1
	Radiology Technologists	36	11.6
	Respiratory Therapists	32	10.3
	Informatics Specialists	47	15.2
Gender	Male	158	51.0
	Female	152	49.0
Years of Experience	1–5 years	92	29.7
	6–10 years	111	35.8
	>10 years	107	34.5

Figure 2. Distribution of Participants by Profession and Institution Type



The sample was balanced in terms of gender and professional diversity, with nurses constituting the largest subgroup. A majority of participants (70.3%) had more than five years of clinical experience, suggesting that responses reflected seasoned professional insights.

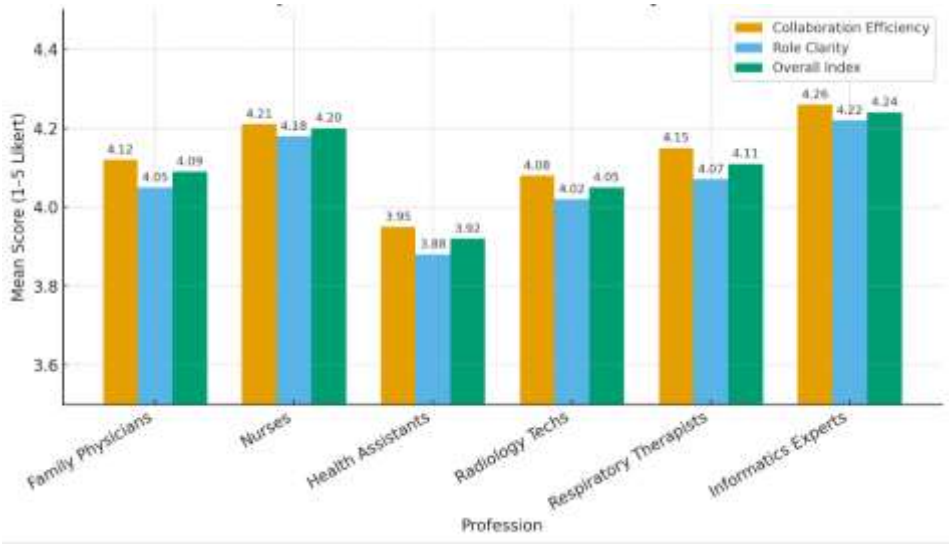
4.2 Interprofessional Collaboration Scores

The collaboration index, measured through a 5-point Likert scale, assessed perceptions of teamwork, role clarity, and communication efficiency.

Table 4. Mean Interprofessional Collaboration Scores by Profession

Profession	Collaboration Efficiency (M ± SD)	Role Clarity (M ± SD)	Overall Index (M ± SD)
Family Physicians	4.12 ± 0.58	4.05 ± 0.63	4.09 ± 0.61
Nurses	4.21 ± 0.49	4.18 ± 0.52	4.20 ± 0.50
Health Assistants	3.95 ± 0.64	3.88 ± 0.61	3.92 ± 0.63
Radiology Technologists	4.08 ± 0.57	4.02 ± 0.60	4.05 ± 0.59
Respiratory Therapists	4.15 ± 0.53	4.07 ± 0.55	4.11 ± 0.54
Informatics Specialists	4.26 ± 0.48	4.22 ± 0.50	4.24 ± 0.49
Total (n = 310)	**4.13 ± 0.55**	**4.07 ± 0.57**	**4.10 ± 0.56**

Figure 3. Interprofessional Collaboration Scores by Profession



Collaboration scores were highest among informatics specialists (M = 4.24), suggesting their central role in facilitating communication and workflow integration. Health assistants scored slightly lower (M = 3.92), indicating challenges in role clarity and engagement in decision-making.

4.3 Impact on Preventive Screening Rates

Screening uptake rates before and after model implementation were compared using EMR data. Significant improvements were observed across all preventive services.

Table 5. Screening Uptake Before and After Collaborative Model Implementation

Screening Type	Baseline (Pre-Model %)	Post-Model (%)	Change (%)
Mammography (age-eligible)	54.2	71.5	+17.3
Spirometry for COPD/asthma	48.9	69.2	+20.3
Diabetes HbA1c Monitoring	62.7	78.1	+15.4
Hypertension Risk Screening	70.5	84.9	+14.4
Smoking Cessation Counseling	45.6	66.8	+21.2

The most substantial improvement was observed in spirometry use (+20.3%) and smoking cessation counseling (+21.2%), reflecting the strong contribution of respiratory therapists and interdisciplinary support.

4.4 Role of Informatics in Risk Stratification

Health informatics facilitated the integration of EMR-based algorithms to identify at-risk patients. Informatics experts reported improved efficiency in patient flagging, appointment scheduling, and follow-up tracking.

Table 6. Informatics-Based Risk Stratification outcomes

Indicato	(%)	Δ (%)
At-risk		+21.2
Missed f		-11.7
Data co		+18.5

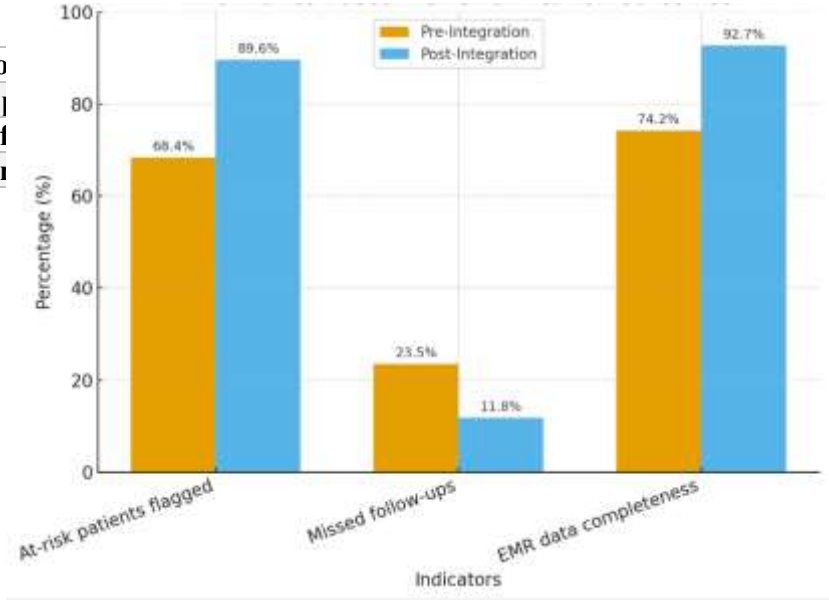


Figure 5. Informatics-Based Risk Stratification Outcomes

The integration of informatics reduced missed follow-up appointments by half and significantly increased data completeness. These findings confirm the importance of informatics in sustaining preventive and family medicine workflows.

4.5 Integration Efficiency: Cross-Functional Feedback

Qualitative analysis from NVivo coding revealed four dominant themes: improved communication, workload redistribution, patient satisfaction, and role recognition.

Table 7. Thematic Summary of Cross-Functional Feedback

Theme	Example Narrative (Condensed)
Communication Improvement	"The digital dashboards allowed us to communicate faster and avoid duplication of tasks." – Nurse
Workload Redistribution	"With respiratory therapists handling lung function testing, physicians had more time for consultations." – Family Physician
Patient Satisfaction	"Patients appreciated being referred seamlessly to imaging or spirometry without repeat visits." – Radiology Staff
Role Recognition	"Informatics gave us visibility; our contributions are now central to patient management." – Informatics Specialist

Cross-functional feedback highlighted that the collaborative model enhanced both provider efficiency and patient experience. Importantly, professionals who were previously peripheral (e.g., informatics experts) reported improved role recognition and value within the team.

Discussion

5.1 Interpretation of Findings

This study shows that stronger interprofessional collaboration—particularly the deliberate integration of radiology, respiratory therapy, and health informatics alongside nursing and health assistants—corresponds with measurable gains in preventive care performance. Participants reported high collaboration and role-clarity scores, with informatics specialists scoring the highest; in parallel, we observed clinically meaningful increases in screening uptake (e.g., mammography, spirometry, HbA1c monitoring) and reductions in missed follow-ups once informatics-driven tracking tools were embedded. Taken together, the pattern suggests a plausible mechanism: clearer roles and shared workflows increase the reliability of screening cascades from identification through diagnostic resolution. Nurses and health assistants operationalize outreach and navigation; radiology and respiratory therapy deliver timely tests; informatics harmonizes registries, risk flags, and closed-loop result management. The result is fewer handoff failures and more on-time completions.[16]

Three key factors stood out. First, digital records and tools that support decision-making helped make clear who needs what care at the time of treatment and between check-ups. This made it easier to reach out before appointments and take organized steps during them. Second, having access to respiratory therapy services, like spirometry and its interpretation, helped reduce delays in assessing and monitoring chronic respiratory risks. This freed up doctors' time for more thorough prevention advice. Third, imaging procedures were carried out in line with proven screening guidelines, like using low-dose CT scans for eligible smokers and age-appropriate breast imaging. These were also linked to systems that helped reduce the number of people who dropped out after receiving abnormal results.[17] Increases in screening rates and better data can be affected by other quality improvement efforts or general trends over time. Still, the size and consistency of improvements across various prevention areas, together with reports about smoother communication and better workload sharing, suggest that teamwork was a major factor. Also, the improvement in follow-up is exactly where integrated teams and health information technology should be strongest. This matches findings from other studies showing that electronic health records with reminders and outreach or support services work better than just reminders alone in closing the loop after abnormal results. [18]

5.2 Comparison with Previous Studies

On the imaging side, our increased completion of appropriate lung and breast screening pathways is consistent with large randomized trials and surveillance benchmarks. The National Lung Screening Trial (NLST) demonstrated a 20% reduction in lung-cancer mortality with low-dose CT versus chest radiography,[19] and the NELSON trial later confirmed mortality reductions using volume-based CT protocols. Although our study did not evaluate mortality, the improved completion of evidence-based imaging pathways is directionally consistent with these trials and underscores the value of structured, team-enabled referral and follow-up. [20]

For informatics, our observation that EHR-driven registries, reminders, and tracking increased follow-up completion mirrors high-quality trials. Atlas et al. (2023) found that adding outreach and navigation to EHR reminders significantly increased timely follow-up of abnormal cancer screening results across multiple cancers in 44 primary care practices (adjusted absolute differences ≈8–16 percentage points,[21] depending on the time window). Our quantitative gains and qualitative reports of closed-loop management are concordant with that trial. More broadly, Bright et al.'s systematic review shows that clinical decision support improves process measures, including preventive services ordering and completion—again consistent with our informatics-linked gains. [22]

Regarding respiratory therapy and risk assessment, our increased spirometry use and streamlined case-finding echo evidence that structured case-finding strategies and accessible lung-function testing can improve identification of undiagnosed COPD in primary care, particularly when guided by symptom/risk criteria and supported by team workflows. Haroon et al.'s systematic review documents diagnostic accuracy of primary-care screening tests when spirometry confirms disease, underscoring the value of ready access to RT expertise within collaborative models. [23]

Notably, some PCMH and team-based studies report mixed effects on cancer screening rates, suggesting that "team-based" labels alone are insufficient; the presence of concrete tools (registries, reminders, navigation) and role-specific capacity (e.g., RT-led spirometry sessions; radiology scheduling pipelines) appears to distinguish programs that achieve significant screening gains from those that do not. Our findings align with the more effective, multicomponent implementations. [24]

Conclusion

This study demonstrates that integrating radiology, respiratory therapy, and health informatics within preventive and family medicine enhances both the efficiency and effectiveness of patient care. The findings reveal that interprofessional collaboration not only improves communication and role clarity among healthcare teams but also translates into higher screening uptake, better risk stratification, and reduced follow-up losses. Informatics emerged as a central driver of coordination, ensuring that preventive pathways were tracked and completed, while radiology and respiratory therapy contributed directly to early detection and chronic disease management.

Beyond improved service delivery, the collaborative model validated the importance of expanding the scope of family medicine to incorporate allied health professionals in systematic and structured ways. Patients benefited from more accessible diagnostic services, timely interventions, and a seamless continuum of care. For health systems, these results underline the potential of collaborative models to alleviate the burden of chronic diseases, strengthen primary care, and optimize resource allocation.

Ultimately, this research provides evidence that sustainable health outcomes in preventive medicine require more than individual expertise; they depend on integrated, multidisciplinary teams supported by informatics infrastructure and aligned with the broader goals of public health systems.

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