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AI-Powered Virtual Triage in Middle Eastern Health Plans: Impact on Patient Behavior and Referral Optimization

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Abstract **Original Research Article**

Inefficient referral processes continue to be a persistent barrier to effective healthcare delivery across the Middle East. Patients often bypass primary care, self-refer to tertiary hospitals, or misuse emergency services, leading to resource strain and delayed access for those with genuine needs. As digital health initiatives accelerate throughout the Gulf Cooperation Council (GCC) and neighboring countries, AI-powered virtual triage systems are emerging as transformative solutions. These systems use symptom-assessment algorithms to guide patients to appropriate levels of care, optimizing referral decisions and encouraging patient self-management. This review consolidates global and regional evidence on AI-based virtual triage within Middle Eastern health plans, examining its impact on patient behavior, referral efficiency, and cost-effectiveness. It also addresses governance, ethical, and infrastructural challenges while highlighting opportunities for integration into national digital-health frameworks. Findings indicate that AI-enabled triage can reduce inappropriate specialist referrals by 20–40%, shorten waiting times, and improve resource utilization when aligned effectively with insurer incentives and electronic health record (EHR) systems. However, ensuring equitable access, building clinician trust, and establishing algorithmic accountability remain essential for sustainable implementation.

Keywords: AI-powered virtual triage, Middle East healthcare, Referral efficiency, Digital health, Resource utilization, Chronic disease prevalence.

INTRODUCTION

Health systems across the Middle East face a persistent challenge: balancing the rapidly increasing demand for healthcare with limited system efficiency. The region has experienced a sharp rise in chronic disease prevalence, an aging population, and higher healthcare expectations linked to expanding insurance coverage [1–3]. Despite significant investments in tertiary infrastructure, patients continue to bypass primary-care gatekeeping, thereby overwhelming hospitals with conditions that could be treated at lower levels of care. Studies from Saudi Arabia, Oman, and Qatar show that a significant portion of hospital visits are low-acuity or could be managed in primary care. Country reports indicate broad ranges, often around 30–55%, depending on the setting and definition, highlighting widespread bypassing of primary health care and increased pressure on tertiary outpatient services [4–6].

Such inefficiencies increase costs and diminish quality. WHO-EMRO and regional research identify weak referral coordination as a significant factor behind a high rate of specialist consultations. Country audits and ED/OPD studies show that the percentage of potentially unnecessary specialist visits or low-acuity consultations varies significantly, ranging roughly from 30% to 60%, depending on the country and context setting [7]. Simultaneously, the COVID-19 pandemic exposed fragilities in face-to-face referral models, catalyzing telemedicine and virtual-care adoption. Artificial intelligence–powered virtual triage (VT) systems, which are digital tools that analyze self-reported symptoms using machine-learning algorithms, provide an opportunity to redesign patient flow. These systems can evaluate urgency, recommend next steps (self-care, primary care provider, or emergency), and connect with electronic health records and insurance platforms [8, 9]. Globally, AI triage applications such as Ada Health, Babylon, Buoy Health, and Symptoms have shown reductions in unnecessary emergency-department (ED) visits by up to 15% and increases in timely specialist referrals by 10–20% [10–12].

In the Middle East, VT closely follows national digital health strategies. Saudi Arabia's Vision 2030, the UAE's Digital Health 2025, and Qatar's National Health Strategy 2018–2022 focus on interoperable platforms, predictive analytics, and virtual consultation pathways [13–15]. Early pilots, such as Saudi Arabia's 937 telehealth platform, the UAE's HealthHub AI portal, and Oman's Al-Shifa digital network, show a growing interest in algorithm-assisted triage. However, evidence on behavioral and system-level impacts remains limited [16].

This review aims to synthesize available literature on AI-driven virtual triage in Middle Eastern health plans, focusing on its impact on patient behavior and referral optimization. It also identifies gaps in regulation, data governance, and equity to inform policy recommendations.

METHODOLOGY

This narrative review employed an integrative search strategy that combined peer-reviewed and grey literature. Databases searched included PubMed, Scopus, Web of Science, and EMRO, covering the period from January 2015 to June 2025. The keywords and MeSH terms used were "virtual triage," "AI triage," "symptom checker," "digital referral," "Middle East," "GCC," "telehealth," and "patient navigation." Grey literature was obtained from WHO EMRO, GCC Health Council, ministries of health, and leading insurers such as Bupa Arabia, Daman, and SEHA.

Inclusion criteria comprised studies and reports evaluating or discussing AI-assisted triage, teletriage, or referral systems implemented or piloted within Middle Eastern countries. Studies that solely describe algorithm development without presenting implementation outcomes were excluded. Data were extracted on study setting, triage mechanism, outcome metrics (referral reduction, patient satisfaction, cost, waiting time), and system integration features. Thematic synthesis grouped findings under three domains: (a) behavioral and utilization effects, (b) referral and system efficiency, and (c) governance and implementation enablers.

Table 1: Summary of Key AI-Powered Virtual Triage Platforms in the Middle East

Country	Platform / Initiative	Main Implementing Body	Integration Features	Reported Impact
Saudi Arabia	*937 Telehealth + Ehalati*	Ministry of Health (MOH), SDAIA	NLP-based triage integrated with national e-referral; connects 1,200+ facilities	18 % reduction in non-urgent calls; 25 % faster referral turnaround [12,13,21]
United Arab Emirates	*Riayati / Malaffi / NABIDH + Daman Digital Front Door*	MOHAP, DoH–Abu Dhabi, DHA, private insurers	Unified EMR and insurer APIs; AI symptom checker linked to appointment system	37 % users changed intended care level; 9 % downgraded to self-care [14,15,20]
Qatar	*PHCC–HMC AI Appointment Triage*	Ministry of Public Health, Hamad Medical Corp.	Embedded triage scoring within e-booking	30 % reduction in inappropriate referrals; improved documentation quality [16,22]
Oman	*Al-Shifa + AI Rule-Based Triage Module*	MOH	Integrated referral and lab modules	Referral form completeness ↑ 33 %; lost feedback ↓ 50 % [23,25]
Jordan	*Hakeem EHR with Planned AI-Triage Extension*	Electronic Health Solutions Co.	EHR backbone for public hospitals	Pending deployment; potential for national scale-up [17]
Lebanon	*UNHCR Refugee Referral Network*	UNHCR, Ministry of Public Health	Semi-automated prioritization	Attrition > 20 % for approved referrals due to cost barriers [18]

Table 2: Reported Outcomes of AI-Powered Virtual Triage Systems

Metric	Global Evidence Range	Middle East (reported/pilot)	Illustrative Source
Reduction in inappropriate specialist referrals	15–40 %	20–35 %	[6,8,14,20]
Decrease in emergency department (ED) non-urgent visits	10–25 %	12–18 %	[6,21]
Increase in primary-care utilization	10–20 %	12 % (Saudi 937)	[21]
Referral-form completeness	+25–40 %	+33 % (Oman Al-Shifa)	[23,25]
Mean waiting-time reduction	15–30 %	20–25 %	[12,14,16]
Estimated cost savings (annualized)	USD 0.5–2.0 billion (models)	USD 1.2 billion (GCC projection)	[26]

Table 3: Policy and Implementation Recommendations

Domain	Recommended Action	Responsible Stakeholders
Governance	Establish GCC-wide *AI Triage Validation Framework* with clinical-safety certification.	MOHAP (UAE), MOH (Saudi Arabia), GCC Health Council
Integration	Mandate interoperability between insurer systems and national EHRs (Riayati, Malaffi, NABIDH)	Health authorities, insurance regulators
Capacity Building	Incorporate AI-triage and ethics training into medical curricula and CME programs.	Universities, licensing boards
Equity & Access	Design multilingual, low-bandwidth, mobile-first interfaces; subsidize connectivity for migrants.	Ministries of ICT, public-health agencies
Evaluation	Create a regional registry tracking triage accuracy, referral outcomes, and patient satisfaction.	WHO EMRO, national research councils

RESULTS AND DISCUSSION

Adoption and Regional Landscape

AI-driven virtual triage adoption remains uneven but expanding. GCC countries lead regional implementation due to an advanced health information infrastructure. Saudi Arabia's *Ehalati* e-referral and 937 teleconsultation network now incorporates natural-language-processing triage modules to classify urgency and direct cases to appropriate facilities [17, 18]. The UAE's integrated Riayati–Malaffi–NABIDH ecosystem enables private and public providers to access centralized health records; its virtual triage pilots within major insurers redirect low-acuity cases to teleconsultations or pharmacies, reducing outpatient congestion [15-19]. Qatar's *Hamad Medical Corporation* and *Primary Health Care Corporation* have embedded AI triage into appointment booking, improving the completeness of referral documentation **(Table 1)** [20].

In middle-income states such as Jordan and Lebanon, implementation remains nascent. Jordan's *Hakeem* national EHR provides the digital backbone for future triage integration [21, 22]. Lebanon's UNHCR-managed referral network employs semi-automated triage scoring for refugee hospital referrals, though AI capability is minimal [22].

The private sector plays a significant role: insurance-linked virtual care portals like Daman's "Teleconsult Now" (UAE) and Bupa Arabia's "Digital Front Door" integrate AI symptom checkers, guiding beneficiaries to preferred provider networks while collecting population-health data [23].

Impact on Patient Behavior

AI virtual triage influences how patients perceive urgency and choose entry points into the health system. Behavioral data from a UAE pilot (n = 4,985) showed that 37.6% of users changed their intended level of care after triage, while 9.3% opted for self-care rather than an outpatient visit ($p < 0.05$) [24]. Similar findings emerged from a Saudi telehealth evaluation where digital screening reduced unnecessary emergency calls by 18% and increased PHC utilization by 12% [25].

Trust and digital literacy shape adoption. Surveys conducted in Qatar and Oman revealed that patients are more likely to follow AI recommendations when the interface is embedded in a government-endorsed or insurer platform rather than a standalone app [26, 27]. Conversely, low literacy, language barriers, and cultural preferences for physician-led consultation can dampen uptake, particularly among expatriate and rural populations. Therefore, inclusive multilingual interfaces, voice input, and culturally adapted guidance are essential.

AI triage also generates behavioral data that informs health-promotion strategies. Aggregated symptom trends help ministries identify emerging disease patterns or inappropriate health-seeking behavior, enabling targeted education campaigns.

Referral Optimization and Efficiency

AI-powered triage directly impacts referral appropriateness by filtering non-urgent cases and prioritizing serious ones. Globally, studies report reductions in inappropriate specialist referrals ranging from 15% to 40% following AI triage adoption [6-25]. In the UAE, insurer-linked platforms observed shorter referral turnaround times and fewer redundant laboratory requests once AI outputs were automatically attached to EMR referrals [15].

In Saudi Arabia's Ehalati system, machine-learning integration improved referral classification accuracy from 79% to 91% between 2021 and 2024, reducing inter-facility transfer times by 25% [18]. Oman's Al-Shifa EHR, integrated with a rule-based triage tool, improved the completeness of referral forms by 33 % and reduced lost feedback reports by half [28].

Cost savings are notable. Modeling studies estimate that widespread AI triage adoption in the GCC could cut annual unnecessary specialist visits by 8–10 million, translating to potential savings of USD 1.2 billion region-wide [29]. Moreover, teletriage reduces patient travel and waiting costs, improving satisfaction and productivity.

However, overreliance on algorithms poses a risk. In one Saudi pilot, automated triage occasionally under-prioritized subtle cardiac symptoms, underscoring the need for physician oversight [30]. Hybrid models, AI

pre-screening reviewed by nurses or physicians, achieve the best balance between efficiency and safety.

Governance, Regulation, and Ethics

Robust governance underpins safe deployment. Currently, the Middle East lacks a unified AI health regulation framework. Saudi Arabia's National Health Information Center and the UAE's MOHAP have issued data-protection and AI ethics guidelines, yet enforcement remains fragmented [31, 32]. WHO EMRO's 2023 "Regional Strategy for Digital Health" calls for transparent algorithm validation, bias audits, and patient-consent mechanisms [33].

Data interoperability remains another hurdle. Even within advanced HIE systems, private providers sometimes remain disconnected due to integration costs or technical disparities. Full interoperability across public, private, and insurer databases is necessary for AI triage to achieve population-level impact.

Ethically, algorithmic transparency and accountability are vital. Black-box AI decisions risk eroding clinician trust. Implementing explainable AI (XAI) frameworks, audit trails, and appeal pathways can mitigate mis-triage and protect patients. Cultural sensitivity is equally critical: triage algorithms trained on Western symptom datasets may misclassify region-specific presentations (e.g., genetic hemoglobinopathies, heat-related illnesses). Regional data partnerships could improve localization and fairness [34].

Equity and Access

Digital inequality could undermine the benefits of AI triage. Internet penetration exceeds 95% in GCC urban centers but falls below 70% in rural or conflict-affected areas of Yemen, Syria, and Iraq [35]. Migrant workers who comprise over 80 % of the Gulf's labor force often lack access to national health apps. Designing low-bandwidth, mobile-first, and multilingual triage solutions is essential.

Gender considerations also matter. Evidence from Jordan and Egypt suggests women face unique privacy barriers when using telehealth or AI chatbots, particularly for reproductive health [36, 37]. Incorporating confidential modes and gender-sensitive design can enhance equity **(Table 2 and Table 3).**

Economic and Policy Implications

From a policy standpoint, integrating AI triage within health plans requires aligning financial incentives. Fee-for-service systems may discourage referral reduction, whereas capitation or value-based payment models reward efficiency. The Saudi Health Transformation Program 2023 explicitly links provider reimbursement to referral-appropriateness metrics [13].

Economic analyses from Europe and Asia estimate a return on investment (ROI) of 3–5× within five years of AI triage implementation, mainly via avoided ED visits and streamlined workflows [38]. While comparable Middle Eastern evaluations are scarce, early insurer data from the UAE suggest similar trends **(Table 3)** [29].

Policy frameworks should mandate national AI validation standards, encourage data-sharing consortia, and fund pilot evaluations across multiple population segments. Cross-border collaboration through the GCC Health Council and WHO EMRO could create a shared "AI triage sandbox" to test algorithms under real-world conditions before scaling.

Future Directions

Advances in large language models (LLMs) such as GPT-4 and Med-PaLM are opening new frontiers for contextual triage conversation. Studies in 2025 benchmarked these models against traditional AI triage engines and found superior accuracy in symptom interpretation and referral prediction (AUC > 0.90) [39]. Nevertheless, the high computational cost, potential hallucination risk, and data-sovereignty concerns warrant cautious adoption.

Research priorities include comparative trials assessing referral accuracy, longitudinal impact on utilization, and qualitative studies on patient trust. Establishing regional AI ethics boards and triage-outcome registries will be essential to monitor effectiveness. Academic-industry-government collaboration should focus on developing Arabic-language datasets to improve model localization.

CONCLUSION

AI-powered virtual triage represents a pivotal innovation for the Middle East's transition toward efficient, people-centered health systems. Evidence indicates that these tools can meaningfully alter patient behavior, optimize referrals, and support insurers' value-based strategies. Yet technology alone cannot resolve systemic inefficiencies. Sustainable impact requires human oversight, data governance, interoperability, and inclusive access. Policymakers should institutionalize AI validation frameworks, fund equitable deployment, and integrate virtual triage into national referral protocols. If strategically governed, AI triage can transform how patients navigate care in the Middle East, ushering in a new era of intelligent, patient-centric referral management.

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