

# ME'NA-ISN Recommendations for the Introduction and Utilization of Live Attenuated Influenza Vaccine (LAIV) in the Gulf Cooperation Council Countries: A Policy and Implementation Roadmap

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## Abstract

Seasonal influenza poses a significant global public health challenge, as also in the Gulf Cooperation Council (GCC) countries, contributing to substantial morbidity, mortality, and economic burden. Despite governmental efforts, influenza vaccination coverage among high-risk groups, including healthcare workers, remains far below WHO-recommended targets. The Live Attenuated Influenza Vaccine (LAIV), administered intranasally, offers a new, promising option due to its ease of administration, acceptability, targeting an absolutely new cohort, and demonstrated efficacy in specific populations, particularly children. We propose the introduction of LAIV as a strategic tool to enhance influenza control in GCC countries, contingent on regulatory approval. We review the compelling evidence of the burden of influenza, its toll on healthcare systems, and the specific advantages LAIV, including its safety and effectiveness and present actionable policy recommendations to integrate LAIV into the national immunisation programs of GCC countries. LAIV represents a viable strategy to build a more resilient defence against seasonal and pandemic influenza threats in the region. Building the most optimal strategies for LAIV implementation, stakeholder engagement, pilot programs, and robust post-marketing surveillance, and attaining and sustaining a high vaccination coverage rate are strongly recommended to ensure successful implementation.

**Keywords:** Seasonal influenza vaccine; Live Attenuated Influenza Vaccine; policy recommendations, Gulf Cooperation Council (GCC) countries; ME'NA-ISN

## Introduction

Seasonal influenza refers to a disease in humans caused by infection with seasonal influenza A or B viruses. Each year, there are an estimated 1 billion cases of influenza, of which 3–5 million are severe, and between 290,000 and 650,000 influenza-related respiratory deaths<sup>1</sup> Morbidity and mortality from influenza in the tropics and subtropics are likely to be underestimated.<sup>2</sup> Annual influenza epidemics of variable severity typically occur during colder periods in temperate climates worldwide.<sup>3</sup> Most people with influenza have self-limited upper-respiratory-tract symptoms with or without systemic signs and symptoms that temporarily affect daily activities, including missing work or school, and some might access medical care.<sup>1,4</sup> Some individuals with influenza, particularly young children, older adults, pregnant people, and those with certain underlying conditions, can have complications related to influenza or the underlying disease (e.g exacerbation of COPD) resulting in medical care visits, hospital admissions, or in-hospital and community deaths.<sup>4</sup> Influenza contributes to a high burden of disease, particularly among vulnerable populations such as children, the elderly, and

individuals with chronic conditions.<sup>5,6</sup> Children have an important role in transmitting the influenza infection in the community, which places an additional emphasis on their vaccination.

The Gulf Cooperation Council (GCC) consists of six member states, including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). The region's unique demographic and environmental factors, including high population density with high turnover, frequent international travel, huge non-citizen population, and seasonal pilgrimages like Hajj and Umrah, amplify influenza transmission risks.<sup>7-11</sup> The high prevalence of non-communicable diseases in the region places the population at elevated risk of adverse outcomes from influenza infection.

Current influenza vaccination strategies in the GCC countries primarily rely on inactivated influenza vaccines (IIVs), but coverage remains low, vaccination coverage amongst the high risk groups is highest for HCWs but even that remains suboptimal, particularly among HCWs and high-risk groups. In a study of HCWs, vaccination rates were 27% in UAE, compared to 46.4% in Oman and 67.2% in Kuwait.<sup>11</sup>

The Live Attenuated Influenza Vaccine (LAIV), approved for individuals aged 2–49 years,<sup>12</sup> offers an alternative approach with potential to increase vaccination uptake due to its needle-free administration and acceptability amongst children and even adults. We herewith evaluate the feasibility of introducing LAIV in the GCC countries, drawing on evidence of influenza burden, healthcare impacts, and LAIV's safety and effectiveness, to propose a structured policy and implementation roadmap for its integration into national immunization programs. The recommendations were drawn from discussions held in Dubai, UAE on May 3, 2025 that involved the in-person participation of the relevant stakeholders representing various medical societies and physician associations of the GCC region including EIDS, EPNS and QIDS.

## **A. The Burden of Influenza and Gaps in Current Control Strategies in the GCC countries:**

### **a. Epidemiological Burden**

Influenza is a major cause of acute respiratory infections globally, with an estimated 1 billion cases annually, including 3–5 million severe cases and 250,000–650,000 deaths.<sup>1,4</sup> In the GCC countries, the burden is significant but underreported due to limited surveillance and economic burden assessments except in Oman and Saudi Arabia.<sup>13,14</sup> Studies indicate that influenza accounts for a substantial proportion of respiratory hospitalizations, particularly among children under 5 years and the elderly. For instance, in Saudi Arabia, influenza-associated hospitalizations are notable during Hajj, where crowded conditions facilitate transmission.<sup>14</sup> Based on the cases reported to the WHO FluNet database, seasonal influenza peaks in the Middle East are parallel to the northern hemisphere (December-March), with influenza activity typically starting in October in the Gulf countries.<sup>7,8</sup> Within the region, there are country-level variations the primary peak weeks for seasonal influenza – Oman, Qatar, Saudi Arabia and the UAE saw peaks starting in November while Bahrain reported peaks in July and August.<sup>8,12</sup> While the pattern of influenza in the Middle East is generally similar to that of temperate countries, smaller secondary peaks are observable in the summer months.<sup>9,14</sup> The year-round risk of influenza in the region presents a challenge for surveillance, prevention and vaccination strategies. While some GCC countries, such as Oman and Saudi Arabia,<sup>13,14</sup> have conducted disease burden assessments, comprehensive evaluations of the economic impact remain lacking. Recent data suggest a significant burden of hospitalizations in Saudi Arabia, especially in the elderly and young children.<sup>6</sup> The scantiness of such data hinders evidence-based policymaking, underscoring the need for enhanced surveillance.

### **b. High-Risk Populations in GCC countries**

In tandem with high-risk populations globally, the various GCC's countries' population groups at elevated risk for severe influenza outcomes include:

- Children under 5 years: High hospitalization rates due to influenza-associated acute lower respiratory infections.<sup>5</sup>
- Elderly: Apart from age leading to increased risk of complications, the presence of comorbidities among this age group increases the risk of adverse outcomes.<sup>5,15</sup>
- Healthcare Workers: Higher risk of infection as a result of occupational exposure against the backdrop of a poor vaccine uptake.<sup>11</sup>

- Pilgrims: Hajj and Umrah attract millions annually, creating super-spreading events for influenza.<sup>14</sup>
- Individuals with Chronic Conditions: High prevalence of diabetes and cardiovascular disease in the GCC increases influenza-related complications.<sup>15-19</sup> The prevalence of DM in the GCC countries has increased over the past two decades, reaching 33.6% in Bahrain, 29.1% in Saudi Arabia, 18.0% in Qatar, 25.4% in Kuwait, 25.8% in the UAE, and 13.1% in Oman.<sup>15</sup> The prevalence of DM is projected to be 37.4% and 51.8% in GCC countries in 2030 and 2050, respectively.<sup>16</sup> Kuwait, Qatar and Saudi Arabia are all in the top 20 countries for the prevalence of obesity, with over 30% of males and 40% of females with the condition.<sup>17</sup> There is an estimated 10.7m sufferers of chronic obstructive pulmonary disease (COPD) in the Middle east and North Africa (MENA) region, according to 2019 Global Burden of Disease (GBD) data, with an age-standardised prevalence rate of 233 per 10,000 population, with the highest prevalence in Turkey and the UAE at 328 and 292 per 10,000 population, respectively.<sup>19</sup> For people with COPD, underlying chronic respiratory, cardiovascular, diabetes or cancer, a viral respiratory infection like seasonal influenza can exacerbate breathing difficulties and lead to life-threatening complications, including an increased risk of stroke, pneumonia, and respiratory failure.<sup>4</sup> These patients often require close monitoring post-infection, contributing to higher hospitalization rates and healthcare costs.
- Individuals with immunocompromises: Immunocompromised patients are also at a higher risk for adverse consequences of influenza infection. By the end of 2021, an estimated 42,015 people living with HIV (PLHIV) were residing in the GCC countries with prevalence levels below 0.01%. Data from four GCC countries, Bahrain, Oman, Qatar and UAE, indicated that by 2021, 94%, 80%, 66%, and 85% of HIV-positive population knew their status, respectively. 68%, 93% (2020 data), 65%, 58% and 85% of PLHIV in Bahrain, Kuwait, Oman, Qatar and UAE who knew their status were on anti-retroviral therapy (ART), respectively and 55%, 92%, 58% and 90% (2020 data) among those who were on ART had viral suppression in Bahrain, Kuwait, Oman and Saudi Arabia, respectively.<sup>20</sup> Similarly an estimated 42,475 new cancer cases and 19,895 deaths occurred in the GCC countries in 2020, with corresponding age-standardized incidence and mortality rates of 96.5 and 52.3 per 100,000, respectively.<sup>21</sup>

### c. Economic and Social Impact

The economic burden of seasonal influenza stems from both direct and indirect costs. Direct costs include doctors' visits, hospitalisation and medications, as well as non-medical expenses such as transportation and food.<sup>22</sup> Hospitalisation is estimated to account for 75% of the direct costs related to seasonal influenza. Indirect costs refer to the value of lost productivity due to absenteeism, presenteeism, reduced working time or the inability to perform at full capacity due to an influenza infection or caregiving for someone with it. The indirect costs or productivity losses account for 88% of the total economic burden of seasonal influenza in adults aged 18 to 64.6 influenza-related costs also increase with age and underlying medical conditions.<sup>6,22</sup> In the GCC countries, where healthcare systems are well-resourced but face capacity challenges during peak influenza seasons, the economic toll is expected to be significant. The lack of published economic burden assessments in the GCC countries limits precise estimates, but global data suggest influenza-related costs are substantial, particularly in high-income settings. In 2015, the economic burden of influenza in the US was estimated at \$11.2 billion (\$6.3–\$25.3 billion) with direct medical costs of \$3.2 billion (\$1.5–\$11.7 billion); adults ≥ 18 years of age accounted for 77.8% of the total direct healthcare burden, which was primarily driven by hospitalization costs.<sup>23</sup> The estimated cost of influenza-associated hospitalisations is 2.5 times higher among at-risk populations.<sup>6,22</sup>

### d. Impact on Healthcare Utilization

Influenza increases demand for outpatient and emergency visits, and hospitalisations. In the GCC, seasonal peaks coincide with winter months and religious pilgrimages,<sup>7,8,12-14</sup> overwhelming healthcare facilities. For example, in Saudi Arabia, influenza-related hospitalizations surge during Hajj, straining intensive care units. The prevalence of viruses markedly increased from 7.4% in pre-Hajj samples to 45.4% in post-Hajj ones in 2013.<sup>14</sup> Children and the elderly account for a significant proportion of admissions, with influenza exacerbating conditions like asthma and COPD.<sup>6</sup> In addition, healthcare workers who are critical to health care delivery get stretched and exhausted due to high patient loads. HCWs also face high occupational risks which are compounded by low vaccination coverage and this can facilitate nosocomial transmission. This not only endangers HCWs but also compromises patient safety.

The vulnerabilities of the health care systems in the GCC countries were highlighted in the COVID-19 pandemic when vaccination programs got affected by supply chain issues and competing priorities. While there is a definite potential for scaling up vaccination efforts, absence of comprehensive influenza vaccination policies in some GCC countries limit preparedness.

## B. Influenza vaccination coverage in GCC countries

Despite support from health ministries, uptake of the predominantly used inactivated influenza vaccine remains suboptimal in GCC countries. Data regarding the overall uptake of influenza vaccines is also scant in the GCC countries.<sup>24</sup> The overall influenza vaccination coverage rate (VCR) has been reported as 31.8% in Saudi Arabia in 2022.<sup>25</sup> Moreover, due to the impact of the Coronavirus disease 2019 (COVID-19) pandemic on public perceptions of seasonal influenza being of mild nature, GCC countries have reported a decrease in the use of influenza vaccinations. In 2023, the average influenza VCR among HCWs in the GCC is reported to range from 22.1% to 66.7%. For individuals with chronic illnesses, the rate is between 1% and 1.2%. Among older adults, the rates vary from 0.2% to 5.7%. Pregnant women exhibit rates from 1.2% to 68%, while the pediatric age group shows rates between 0.7% and 6.4%.<sup>26</sup> It is important to note that the GCC member states, while sharing commonalities, exhibit heterogeneity in their healthcare infrastructure, policy maturity, and surveillance capabilities, as summarized in Table 1. This variation necessitates a tailored, rather than a one-size-fits-all, approach to the introduction of LAIV.

**Table 1:** Comparison of Influenza Vaccination Landscape in the GCC countries.

Country	Documented Burden Studies?	Reported Coverage in High-Risk Groups	National Immunization Program (NIP) Scope	Remarks for readiness for LAIV
Bahrain	Limited	Data needed	Standard EPI	Potential for pilot programs
Kuwait	Limited	HCWs: 67.2% <sup>11</sup>	Standard EPI	Strong existing HCW program?
Oman	Yes <sup>5,13</sup>	HCWs: 46.4% <sup>11</sup> Recently dipped	Robust surveillance	Could lead post-introduction studies
Qatar	Limited	HCWs: ~45% (2024 est., manuscript)	Well-resourced	Potential for rapid rollout
Saudi Arabia	Yes <sup>7,14</sup>	Overall: 31.8% HCWs: 77.7% (2024) <sup>25</sup>	Large, complex NIP	Key market for integration
UAE	Limited data	HCWs: 27% <sup>11</sup>		

The influenza VCR among HCWs have dipped in GCC countries (table 1), for example in Oman from 87.6% in 2020 to just 29.5% in 2024 and from 79% in 2020 in Qatar to about 45% in 2024. However, the rates

have steadily registered an increase in Saudi Arabia to about 77.7% in 2024.<sup>25</sup> Recent calls for prioritised vaccination of high risk groups like diabetics and the elderly have been voiced.<sup>24,27</sup> These coverage data illustrate the inadequacy of current IIV-based strategies to reach target groups.

### C. The Strategic Role of LAIV in the GCC countries Context:

Given the substantial burden of influenza and the persistent gaps in coverage with IIVs, a paradigm shift in vaccination strategy is warranted. The Live Attenuated Influenza Vaccine (LAIV), with its unique characteristics, offers a strategic opportunity to directly address these challenges, particularly among key transmitter (children) and protector (HCWs) populations.

LAIV is a nasally administered vaccine containing attenuated influenza viruses that replicate in the cooler nasopharynx but not in the warmer lower respiratory tract. Approved for individuals aged 2–49 years, LAIV is cold-adapted and temperature-sensitive, ensuring safety by preventing severe infection. The cold adapted property ensures that it can replicate at the required site of action (nasal mucosa) and not at other places of the body including the warmer lower respiratory tract. The needle free administration is an attractive mode of usage among the children and is likely to have a higher acceptance by the parents. In appropriate adults too, nasal administration makes the usage easier and perhaps with better acceptance.<sup>28</sup> Table 2 summarises the differences between the inactivated and the live influenza vaccine.

**Table 2:** Comparison of Live inactivated Influenza Vaccine with Inactivated Influenza vaccine.

Feature	Live Attenuated Influenza Vaccine (LAIV)	Inactivated Influenza Vaccine (IIV)
Route of Administration	Intranasal (needle-free)	Intramuscular (injection)
Eligible Age Groups	2 - 49 years	6 months and above
Immune Response	Mucosal IgA & Cell-mediated (potentially broader)	Systemic IgG (humoral)
Key Advantages	High acceptability in children; potential for faster rollout; may offer cross-protection	Wide age range; for immunocompromised
Common Side Effects	Runny nose, sore throat	Injection site pain, myalgia
Contraindications	Severe immunodeficiency, pregnancy	Severe allergy to vaccine component

The effectiveness of LAIV, like all influenza vaccines, can vary. Notably, studies in the United States between 2013-2016 indicated reduced effectiveness against the A(H1N1)pdm09 strain, leading to a reformulation that restored efficacy. In contrast, the United Kingdom's childhood vaccination program has demonstrated consistently high effectiveness and significant herd effects. This global experience underscores that LAIV is a highly effective tool, but it also highlights the critical need for GCC-specific post-introduction effectiveness studies to guide its optimal use in the region. GCC-specific cost-effectiveness studies need to be a primary research model.

#### a. Effectiveness of Live Attenuated Influenza Vaccine (LAIV)

LAIV has been shown to provide a good overall protection for children against influenza infection and is expected to even provide some cross-protection against mismatched circulating strains. LAIV is believed to provide a broader protection than IIVs and as such has a potential to offer protection against drifted strains too.<sup>29,30</sup>

Live attenuated viruses stimulate broader immune responses, engaging both mucosal and cellular immunity components. Which results in the production of locally important IgA antibody as well as a cellular T-cell mediated response. Vaccine effectiveness varies from season to season depending on the circulating strains and the vaccine composition. The overall adjusted vaccine effectiveness for 2023 to 2024 for 2 to 17-year-olds was 54% (the majority of children will have received LAIV).<sup>28</sup> A meta-analysis suggested an

efficacy of LAIV against confirmed disease of 83% (95% confidence interval 69-91).<sup>31</sup> The more recent UK results have confirmed consistently good effectiveness for LAIV.<sup>32-34</sup> A recent meta-analysis assessed LAIV4 and IIV4 VE in children from 2019 to 2023 and reported that VE against influenza infection (all strains) was 61.9 % for LAIV4 and 45.7 % for IIV4 whereas individual strain VE in the 2022/23 season was 75.7 % for LAIV4 and 58.5 % for IIV4. The authors concluded that VE for LAIV4 and IIV4 in children was moderate and comparable across seasons.<sup>35</sup>

LAIV vaccination of primary school age children is associated with population-level benefits, particularly in reducing infection incidence in primary care.<sup>36</sup> In a large study of real world vaccine effectiveness, a comparable moderate effectiveness of LAIV and IIV in Italian children was reported.<sup>37</sup> When vaccine strains are mismatched with circulating strains, LAIV may outperform IIV.

## **b. Challenges and Variability**

LAIV effectiveness, very much like the inactivated influenza vaccines, varies due to strain mismatch or , pre-existing immunity. Regional differences as have been reported in United Kingdom (UK) and the United States (US), the former and Finland reporting significant VE, unlike the US, highlighting the need for region-specific data.

## **c. Safety Profile**

Extensive studies confirm LAIV's safety in eligible populations: A systematic review of 14 studies involving 1.2 million participants in age ranges of 2-49 years found no increased risk of wheezing or respiratory events in children aged 2–17 years with mild to moderate asthma or recurrent wheezing.<sup>38</sup> Adults (18–49 years): LAIV is well-tolerated, with mild side effects (e.g., runny nose, sore throat) that resolve quickly. No evidence suggests increased hospitalization or severe outcomes.<sup>29</sup>

Early concerns about wheezing in children aged 6–23 months led to age restrictions, but subsequent studies have clarified LAIV's safety in older children and adults with stable asthma. The risk of vaccine virus transmission is low, with no documented cases in healthcare settings.<sup>28</sup>

## **d. Cost-effectiveness and socio-economic benefits of vaccination:**

Studies from multiple high- and middle-income countries indicate that LAIV is cost-effective in preventing influenza, particularly among children and working-age adults, resulting in substantial reductions in healthcare expenditure related to medical visits, hospitalizations, and antiviral treatments.<sup>39</sup>

The vaccine's indirect economic benefits are notable, as reduced influenza transmission correlates with fewer lost workdays and higher overall productivity, translating into measurable national income gains. Only few economic model analyses explicitly addressed the use of LAIV. One study from the USA<sup>40</sup> evaluated the cost-effectiveness of LAIV relative to TIV in children aged 24–59 months found that, compared to TIV, vaccinating children with LAIV was associated with cost savings due to higher efficacy of LAIV. Another US-based study,<sup>41</sup> projected cost-effectiveness ratios of \$15,000 per QALY for LAIV and \$18,000 per QALY for TIV when vaccinating non-high-risk children. However in another study which adopted a societal perspective and. <sup>42</sup> found that the use of LAIV resulted in net cost savings. when the cost per dose was at or below \$36 assuming no parental absence from work to obtain childhood influenza vaccination. A recent study reported that influenza vaccination is cost-effective with costs nearly eight times lower than treatment.<sup>43</sup> In the GCC, influenza vaccination was found to be cost-effective for the general population in the UAE and in Iraq. <sup>44</sup> In high-risk patients, vaccination showed dominance in all age groups (except 18-49 in Iraq - it showed cost effectiveness), while in non-high-risk patients, dominance was shown in 0-4 years and 65+ years age groups. Additionally, the vaccine demonstrated cost-effectiveness for the general population in all scenario analyses, except for vaccine efficacy scenario in Iraq.<sup>44</sup> Given the region's strong healthcare infrastructure and high economic dependence on a productive workforce, implementation of LAIV could yield both direct cost savings and wider societal benefits by lowering influenza-related morbidity and maintaining economic stability

## **d. Contraindications and Precautions**

Table 3 lists the contraindications and precautions for the use of LAIV, emphasising differing stances of the Advisory Committee on Immunization Practices (ACIP)<sup>12</sup> and the UK regulatory authorities.<sup>28</sup> While ACIP lists most of the situations listed below as contraindications for the use of LAIV, they are listed as precautions by the UK regulatory authorities based on their safety data and experience. (Table 3)

**Table 3:** Summarizing the contraindications and precautions for Live Attenuated Influenza Vaccine (LAIV).

Category	ACIP (U.S. CDC) Recommendations <sup>12</sup>	UK (JCVI / MHRA) Recommendations <sup>28</sup>	Rationale / Remarks
<b>Contraindications</b>	History of severe allergic (anaphylactic) reaction to any previous dose of LAIV or its components (except ovalbumin)	Same contraindication recognized. Children with previous history of egg allergies can be safely vaccinated. <sup>45</sup>	Prevents recurrence of life-threatening hypersensitivity reactions.
	Immunocompromised individuals (due to disease or therapy, e.g., immunosuppressive drugs, congenital or acquired immunodeficiency, untreated HIV, asplenia or functional asplenia such as sickle cell disease)	Same; however, JCVI allows limited clinician discretion in well-controlled or mildly immunocompromised cases	Live vaccines may cause uncontrolled replication in immunocompromised hosts.
	Active CSF leak between subarachnoid space and nasopharynx, oropharynx, nose, or ear	Same	Potential for vaccine virus invasion into the CNS.
	Pregnancy (added by global recommendations, e.g., WHO and ACIP).	Same	Potential risk from live virus to fetus, though theoretical. Limited studies show no evidence of significant maternal adverse outcomes. <sup>46</sup> Breast feeding can be continued as the virus is not excreted in breast milk.
<b>Precautions / Relative Contraindications</b>	Asthma or recurrent wheezing in children aged 2–4 years (diagnosed asthma or any wheezing episode in past 12 months) – should not receive LAIV <sup>12</sup>	JCVI lists asthma as a precaution, not a contraindication, unless severe or unstable	Concern for bronchospasm post-vaccination in younger children.

	Moderate-to-severe acute illness with or without fever	Same	Vaccine deferred to avoid confusing adverse event attribution.
	Close contact with severely immunocompromised individuals (e.g., HSCT recipients in protective isolation)	Same	Risk of transmitting live vaccine virus to highly vulnerable persons.
	Guillain-Barré Syndrome within 6 weeks of prior influenza vaccination	Same	Safety precaution pending individual risk–benefit assessment.

#### e. Religious considerations

GCC countries have a dominant Muslim population and the religious acceptability of vaccines containing porcine-derived gelatin is crucial for successful implementation in the GCC countries. Highly sensitive scientific analysis confirms that the gelatin in LAIV is highly hydrolyzed, breaking down to a point where the original source material is undetectable.<sup>47</sup> This has led influential Islamic bodies, including the British Fatwa Council and the Qatar Ministry of Endowments and Islamic Affairs ([Islamweb.com](http://Islamweb.com)), to issue Fatwas deeming the vaccine permissible (*halal*), as the ingredient has been completely transformed from its original state.<sup>48,49</sup> A key recommendation of this paper is for GCC health ministries to proactively engage with national and local religious leaders to review this evidence and secure supportive Fatwas *prior* to introduction, thereby building essential public trust

#### ME'NA-ISON Policy Recommendations for LAIV Introduction in GCC Countries.

ME'NA-ISON recommends the introduction of LAIV in the GCC countries with the following recommendations:

##### a. Target Populations

- Children (2–17 years)
- Healthcare workers (18–49 years)
- Healthy adults (18–49 years)
- Pilgrims: Pre-Hajj/Umrah vaccination with LAIV for eligible individuals could mitigate outbreaks.

##### b. Integration into National Immunization Programs

- Develop National Policies: GCC countries without influenza vaccination policies should establish guidelines prioritizing LAIV for eligible groups while those with robust vaccination programs need to integrate LAIV into their existing programs. It is important to engage national regulatory authorities early to streamline approval timelines.
- School-Based Campaigns: We explicitly recommend the feasibility of school-based vaccination programs as a highly efficient model for achieving high coverage in children, who are key drivers of influenza transmission, as has been demonstrated in countries like the UK.
- HCW Vaccination: Encourage LAIV vaccination for HCWs, supported by education campaigns to address vaccine hesitancy.

- Pilgrimage Protocols: Appropriate ministries could consider incorporation of LAIV into pre-travel health requirements for Hajj and Umrah, ensuring compliance through travel clinics, after satisfying any religious issues associated with the use of excipients in the vaccine formulation. The choice of the type of the vaccine should be left to the participant.

#### **c. Education and Awareness**

- Public Campaigns need to aggressively address vaccine hesitancy through community-based education, emphasizing LAIV's safety and needle-free administration. The Gambia's success with LAIV acceptability highlights the role of sensitization.
- Healthcare Worker Training: Healthcare workers play a critical role in vaccine uptake and should receive targeted training to address safety, administration, and public concerns regarding LAIV. We emphasize the critical need for training healthcare workers on administration and addressing common questions, and for public campaigns to build trust.
- Stakeholder Engagement: All important stakeholders and influencers like religious leaders, school teachers, prominent personalities in the entertainment and sports industry, and media can be utilized to promote vaccination, particularly during pilgrimage seasons.
- A key recommendation of this paper is for GCC health ministries to proactively engage with national and local religious leaders to review this evidence and secure support in order to build essential public trust.

#### **d. Surveillance and Monitoring**

- Burden Assessments: Conduct influenza burden and economic impact studies in each GCC country to inform resource allocation.
  - Vaccine Effectiveness Studies: Establish sentinel surveillance to monitor LAIV effectiveness against circulating strains, addressing regional variability.
  - Adverse Event Reporting: Implement robust pharmacovigilance systems to track LAIV safety, building on WHO GISRS frameworks.
- e. **Supply and Distribution:** Appropriate supply chain to be ensured which could be piggyback on the existing cold chain systems. Private sector engagement may be considered for improving access.
- e. **Research:** GCC health ministries should fund research on LAIV effectiveness against GCC-specific influenza strains. Research should be conducted on cost-effectiveness to justify the investment. Track vaccination coverage, hospitalization rates, and influenza incidence pre- and post-LAIV introduction and regular review annually.

## **Conclusion**

The introduction of LAIV in GCC countries offers a viable strategy to address the substantial burden of influenza, reduce healthcare system strain, and protect vulnerable populations. The proven safety and effectiveness, particularly in children and healthy adults, make it a valuable tool for increasing vaccination coverage by circumventing injection associated hesitancies. By implementing targeted policies, enhancing surveillance, and fostering regional collaboration, the GCC can strengthen its influenza control framework. Pilot programs, stakeholder engagement, and robust monitoring will ensure successful LAIV integration, paving the way for a resilient public health response to seasonal and pandemic influenza threats in the GCC countries.

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## Ethics approval

Human subjects were not included in the data collection, either via interviews or the use of patients' personal data files. The researchers utilized existing data and information collected from which had previously been published in an official domain and adhered to the Declaration of Helsinki, therefore ethical clearance was waived.

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