

CADTH RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS

# Influenza Vaccinations for the Prevention of Hospital Admissions: Clinical Effectiveness

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## Research Question

1. What is the clinical effectiveness of the influenza vaccination for the reduction of influenza-related hospitalizations?

## Key Findings

Two systematic reviews (one with meta-analysis) and 36 non-randomized studies were identified regarding the clinical effectiveness of the influenza vaccination for the reduction of influenza-related hospitalizations.

## Methods

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No methodological filters were applied. Where possible, retrieval was limited to the human population. The search was limited to English language documents published between January 1, 2012 and December 30, 2017. Internet links were provided, where available.

## Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

**Table 1: Selection Criteria**

<b>Population</b>	Patients (>2 years of age) eligible for influenza vaccination
<b>Interventions</b>	Influenza vaccine
<b>Comparators</b>	No vaccination
<b>Outcomes</b>	Influenza-related hospital or emergency department admissions
<b>Study Designs</b>	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies

## Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials and non-randomized studies.

Two systematic reviews (one with meta-analysis), and 36 non-randomized studies were identified regarding the clinical effectiveness of the influenza vaccination for the reduction of influenza-related hospitalizations. No relevant health technology assessments or randomized controlled trials were identified

Additional references of potential interest are provided in the appendix.

## Overall Summary of Findings

Two systematic reviews<sup>1-2</sup> (one with meta-analysis)<sup>1</sup> and 36 non-randomized studies<sup>3-38</sup> were identified regarding the clinical effectiveness of the influenza vaccination for the reduction of influenza-related hospitalizations. Detailed study characteristics are provided in Table 2.

Overall, studies evaluating the clinical effectiveness of influenza vaccination provided evidence to suggest that the vaccine is effective in reducing influenza-related hospital or emergency department admissions.<sup>1-38</sup> Both identified systematic reviews concluded that influenza vaccination decreased hospital admissions.<sup>1-2</sup> Of the 38 studies identified, only two did not report an association between vaccine use and decreased hospitalizations.<sup>9,18</sup> One of these studies suggested that the lack of effectiveness was the result of a vaccine-mismatched A(H3N2) epidemic strain.<sup>18</sup>

**Table 2: Summary of Included Studies on the Clinical Effectiveness of Influenza Vaccination for the Reduction of Influenza-Related Hospitalizations**

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Systematic Reviews and Meta-Analyses					
Restivo, 2017 <sup>1</sup>	<ul style="list-style-type: none"> <li>MA performed</li> <li>38 case-control and cohort studies included</li> <li>Patient groups at high-risk of influenza</li> <li>N = NR</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE on influenza visits and hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination demonstrated a clear effect on decreasing influenza visits and hospitalizations in high-risk groups (subjects with underlying health conditions, pregnant women, and health care workers)</li> </ul>
Graverholt, 2014 <sup>2</sup>	<ul style="list-style-type: none"> <li>5 SRs and 5 primary studies included</li> <li>Patients living in nursing homes</li> </ul>	<ul style="list-style-type: none"> <li>Interventions to reduce hospitalizations from nursing homes</li> </ul>	<ul style="list-style-type: none"> <li>Not specified in abstract</li> </ul>	<ul style="list-style-type: none"> <li>Rate of acute hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>Very low to low quality evidence reported that influenza vaccination decreased hospital admissions</li> </ul>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
	<ul style="list-style-type: none"> <li>N = NR</li> </ul>	(including influenza vaccination)			
Non-Randomized Studies					
Arriola, 2017 <sup>3</sup>	<ul style="list-style-type: none"> <li>N = NR</li> <li>Patients aged ≥18</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Death</li> <li>ICU admission</li> <li>Hospital and ICU lengths of stay</li> </ul>	<p><i>“Influenza vaccination during 2013-14 influenza season attenuated adverse outcome among adults that were hospitalized with laboratory-confirmed influenza”<sup>3</sup></i></p>
Cheng, 2017 <sup>4</sup>	<ul style="list-style-type: none"> <li>N = 12,728</li> <li>Patients aged &gt;9</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against hospitalization with influenza</li> </ul>	<p><i>“Vaccination in both the current and previous seasons was associated with a higher VE against hospitalization with influenza than vaccination in either single season. These findings reinforce current recommendations for annual influenza vaccination, particularly those at greatest risk of influenza disease.”<sup>4</sup></i></p>
Dominguez, 2017 <sup>5</sup>	<ul style="list-style-type: none"> <li>N = 2,554</li> <li>Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE in preventing hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination was effective for reducing hospitalizations in elderly people</li> </ul>
Mohseni, 2017 <sup>6</sup>	<ul style="list-style-type: none"> <li>N = 59,202</li> <li>Patients with chronic heart failure</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Number of hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination was associated with a lower risk of hospitalization due to cardiovascular disease, respiratory infections, and all-cause hospitalizations</li> </ul>
Pebody, 2017 <sup>7</sup>	<ul style="list-style-type: none"> <li>N = NR</li> <li>Children aged 2-6 years</li> </ul>	<ul style="list-style-type: none"> <li>Live attenuated influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against laboratory-confirmed influenza hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>Vaccination against influenza was effective in reducing laboratory-confirmed influenza hospitalizations</li> </ul>
Rondy, 2017 <sup>8</sup>	<ul style="list-style-type: none"> <li>N = 5,295</li> <li>Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against laboratory-confirmed influenza hospitalization</li> </ul>	<p><i>“Our results suggest that, regardless of patients’ recent vaccination history, current seasonal vaccine conferred some protection to vaccinated patients against hospitalisation with influenza A(H3N2) and B. Vaccination of patients</i></p>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
					<i>already vaccinated in both the past two seasons did not seem to be effective against A(H1N1)pdm09.</i> <sup>8</sup>
Zhang, 2017 <sup>9</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients who were hospitalized</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against laboratory-confirmed influenza hospitalization</li> </ul>	<i>“Influenza vaccination did not show effective protection against hospitalization with influenza in 2015/16 season in Beijing.”</i> <sup>9</sup>
Bissielo, 2016 <sup>10</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients in New Zealand</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against laboratory-confirmed influenza hospitalizations and primary care visits</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination was moderately effective for reducing influenza hospitalizations and primary care visits</li> </ul>
Havers, 2016 <sup>11</sup>	<ul style="list-style-type: none"> <li>• N = 1,141</li> <li>• Patients aged ≥50</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against laboratory-confirmed influenza hospitalizations</li> </ul>	<i>“During 2010-2011, influenza vaccination was associated with a significant reduction in the risk of laboratory-confirmed influenza hospitalization among adults aged ≥50 years, regardless of age group.”</i> <sup>11</sup>
Lytras, 2016 <sup>12</sup>	<ul style="list-style-type: none"> <li>• N = 883</li> <li>• Greek hospital inpatients</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against laboratory-confirmed influenza hospitalizations</li> </ul>	<i>“Circulating A/H3N2 viruses showed substantial antigenic drift, while about half of the type B strains were similar to the vaccine strain. Despite the antigenic drift of the A/H3N2 strains, the vaccine still offered substantial protection against hospitalization with laboratory-confirmed influenza, mostly due to a surge in type B influenza late in the season.”</i> <sup>12</sup>
Qin, 2016 <sup>13</sup>	<ul style="list-style-type: none"> <li>• N = 2,368</li> <li>• Patients admitted to five hospitals in Beijing</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE in preventing hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>• VE in preventing hospitalization was estimated at 46.9% and 5.0% for the 2013-14 and 2014-15 seasons, respectively</li> </ul>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Rondy, 2016 <sup>14</sup>	<ul style="list-style-type: none"> <li>N = 846</li> <li>Hospitalized patients aged ≥18</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against hospitalized laboratory-confirmed influenza</li> </ul>	<p><i>“These results suggest a moderate and age varying effectiveness of the 2013-14 influenza vaccine to prevent hospitalised laboratory-confirmed influenza. While vaccination remains the most effective prevention measure, developing more immunogenic influenza vaccines is needed to prevent severe outcomes among target groups.”<sup>14</sup></i></p>
Vamos, 2016 <sup>15</sup>	<ul style="list-style-type: none"> <li>N = 124,503</li> <li>Adults with type 2 diabetes</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Admission to hospital for acute myocardial infarction, stroke, heart failure, and pneumonia or influenza</li> <li>All-cause death</li> </ul>	<ul style="list-style-type: none"> <li>Vaccination was associated with significantly lower hospital admission rates for stroke, heart failure, and pneumonia or influenza, as well as all-cause death</li> </ul>
Blyth, 2015 <sup>16</sup>	<ul style="list-style-type: none"> <li>N = 691</li> <li>Children in Western Australia</li> </ul>	<ul style="list-style-type: none"> <li>Trivalent inactivated influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE in preventing laboratory-confirmed influenza-associated hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>Although vaccine uptake was low, VE was estimated to be 62.3% in preventing laboratory-confirmed influenza-associated hospitalization</li> </ul>
Cheng, 2015 <sup>17</sup>	<ul style="list-style-type: none"> <li>N = 2,399</li> <li>Adults in Australia</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against hospitalization with laboratory-confirmed influenza</li> </ul>	<p><i>“We estimate that the influenza vaccine was moderately protective against hospitalisation with laboratory-confirmed influenza during the 2014 influenza season in Australia.”<sup>17</sup></i></p>
Gilca, 2015 <sup>18</sup>	<ul style="list-style-type: none"> <li>N = 314</li> <li>Elderly individuals in Quebec</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against A(H3N2) hospitalization</li> </ul>	<p><i>“The 2014/15 mismatched influenza vaccine provided elderly patients with no cross-protection against hospitalization with the A(H3N2) epidemic strain, reinforcing the need for adjunct protective measures among high-risk individuals and improved vaccine options.”<sup>18</sup></i></p>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
Mahmud, 2015 <sup>19</sup>	<ul style="list-style-type: none"> <li>N = 9,727</li> <li>Patients in Manitoba</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE in preventing pneumonia and influenza hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>Vaccination was associated with a 55-60% reduction in pneumonia and influenza hospitalizations in children and younger adults</li> <li>Although this effect was less dramatic in adults aged ≥65, the vaccine still had a significant impact</li> </ul>
Puig-Barbera, 2015 <sup>20</sup>	<ul style="list-style-type: none"> <li>N = NR</li> <li>Patients in Valencia</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against admission with influenza</li> </ul>	<p><i>“Adjusted influenza vaccine effectiveness was 33% (range: 6-53%) overall and 40% (range: 13% to 59%) in those 65 years and older. Vaccination reduced by 44% (28-68%) the probability of admission with influenza.”</i><sup>20</sup></p>
Song, 2015 <sup>21</sup>	<ul style="list-style-type: none"> <li>N = 2,262</li> <li>Patients with influenza-like illness</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> <li>Pneumococcal vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE in preventing pneumonia development and hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination was effective in preventing pneumonia development and hospitalization</li> </ul>
Cheng, 2014 <sup>22</sup>	<ul style="list-style-type: none"> <li>N = 631</li> <li>Patients admitted to hospital with influenza confirmed by nucleic acid testing</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Vaccine protection against hospitalization with influenza</li> </ul>	<p><i>“Our results suggest that the seasonal influenza vaccine was moderately protective against hospitalisation with influenza in the 2013 season.”</i><sup>22</sup></p>
Dawood, 2014 <sup>23</sup>	<ul style="list-style-type: none"> <li>N = 1,545</li> <li>Patients aged ≥50</li> </ul>	<ul style="list-style-type: none"> <li>Trivalent inactivated influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against hospitalization with influenza-associated acute respiratory infection</li> </ul>	<p><i>“The 2010 and 2011 [inactivated influenza vaccines] were moderately effective against hospitalization with influenza-associated [acute respiratory infection] among Thais aged ≥/ = 50 years, but [inactivated influenza vaccine] coverage was low.”</i><sup>23</sup></p>
Lee, 2014 <sup>24</sup>	<ul style="list-style-type: none"> <li>N = 5,063</li> <li>Frail seniors</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against hospitalization and mortality</li> </ul>	<p><i>“Influenza vaccination was effective against hospitalization and mortality among the frail elderly. These results uphold the current</i></p>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
					<i>universal influenza vaccination policy, and encourage policymakers to adopt strategies to improve vaccination use.</i> <sup>24</sup>
McNeil, 2014 <sup>25</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients in Canada</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE in preventing laboratory-confirmed influenza-related hospitalization</li> </ul>	<i>“Interim unmatched vaccine effectiveness adjusted for age and presence of one or more medical comorbidities was determined by test-negative case-control design to be 58.5% (90% confidence interval (CI): 43.9-69.3%) overall and 57.9% (90% CI: 37.7-71.5) for confirmed influenza A(H1N1).</i> <sup>25</sup>
Puig-Barbera, 2014 <sup>26</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Adult patients</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against hospitalization with laboratory-confirmed influenza</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination had a low to moderate effect against hospital admission with laboratory-confirmed influenza in adults targeted for influenza vaccination</li> </ul>
Puig-Barbera, 2014 <sup>27</sup>	<ul style="list-style-type: none"> <li>• N = 1,914</li> <li>• Patients aged ≥18</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against hospitalization with PCR-confirmed influenza</li> </ul>	<i>“The split-influenza vaccine was effective in preventing influenza-associated hospitalizations in adults aged under 65. The intradermal vaccine was moderately effective in those aged 65 and over.</i> <sup>27</sup>
Turner, 2014 <sup>28</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients with a severe acute respiratory infection or influenza-like illness</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE for the prevention of general practice visits and hospitalizations for laboratory-confirmed influenza</li> </ul>	<i>“This study found moderate effectiveness of influenza vaccine against medically attended and hospitalised influenza in New Zealand, a temperate, southern hemisphere country during the 2013 winter season.</i> <sup>28</sup>
Turner, 2014 <sup>29</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients with a severe acute respiratory infection or influenza-like illness</li> </ul>	<ul style="list-style-type: none"> <li>• Seasonal trivalent inactivated influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE for the prevention of influenza hospitalizations and primary care visits</li> </ul>	<i>“VE adjusted for age and time of admission among all ages against severe acute respiratory illness hospital presentation due to laboratory-confirmed influenza was 54% (95% CI: 19 to 74) and specifically against</i>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
					<i>A(H1N1)pdm09 was 65% (95% CI:33 to 81). For influenza-confirmed primary care visits, VE was 67% (95% CI: 48 to 79) overall and 73% (95% CI: 50 to 85) against A(H1N1)pdm09.</i> <sup>29</sup>
Turner, 2014 <sup>30</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients (any age) with a severe acute respiratory infection</li> </ul>	<ul style="list-style-type: none"> <li>• Trivalent inactivated influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE for the prevention of laboratory-confirmed influenza hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination was reported to have a low to moderate protection against influenza positive hospitalisation</li> </ul>
Chan, 2013 <sup>31</sup>	<ul style="list-style-type: none"> <li>• N = 1,859</li> <li>• Older adults residing in a nursing home</li> </ul>	<ul style="list-style-type: none"> <li>• Trivalent seasonal influenza vaccine</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• All-cause mortality</li> <li>• Pneumonia-related mortality</li> <li>• All-cause hospitalization</li> <li>• Pneumonia-related hospitalization</li> </ul>	<i>“Vaccination of trivalent seasonal influenza vaccine in Chinese nursing home older adults significantly reduced all-cause and pneumonia-related mortality and hospitalization.”</i> <sup>31</sup>
Cheng, 2013 <sup>32</sup>	<ul style="list-style-type: none"> <li>• N = 1,982</li> <li>• Hospitalized patients</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against hospitalization with confirmed influenza</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination was moderately protective against hospitalization with confirmed influenza</li> </ul>
Chiu, 2013 <sup>33</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE in preventing influenza- and pneumonia-associated outpatient visits and hospitalization</li> </ul>	<i>“Vaccination against influenza reduced hospitalization for influenza and pneumonia in elderly Taiwanese people. These results are meaningful for the promotion of vaccination policy. Annual influenza vaccination of the elderly should be encouraged.”</i> <sup>33</sup>
Kwong, 2013 <sup>34</sup>	<ul style="list-style-type: none"> <li>• N = NR</li> <li>• Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• VE against laboratory-confirmed influenza hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>• Influenza vaccination was associated with a 42% reduction in laboratory-confirmed influenza hospitalizations</li> </ul>
Ridenhour, 2013 <sup>35</sup>	<ul style="list-style-type: none"> <li>• N = 1.4 million</li> <li>• Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>• Inactivated influenza vaccines</li> </ul>	<ul style="list-style-type: none"> <li>• No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>• All-cause deaths</li> <li>• Deaths occurring within 30 days of pneumonia or influenza</li> <li>• Hospitalizations</li> </ul>	<i>“By using confounding-reducing techniques with 15 years of provincial-level data including vaccination and health outcomes, we estimated that influenza</i>

First Author, Year	Study Characteristics	Intervention	Comparator	Outcomes	Conclusions
				<ul style="list-style-type: none"> <li>Pneumonia or influenza hospitalizations</li> </ul>	<i>vaccination prevented ~4% of influenza-associated hospitalizations and deaths occurring after hospitalizations among older adults in Ontario.</i> <sup>35</sup>
Rondy, 2013 <sup>36</sup>	<ul style="list-style-type: none"> <li>N = 1,145</li> <li>Hospitalized patients (aged ≥18) presenting an influenza-like illness</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE against laboratory-confirmed A(H3N2) influenza hospitalization</li> </ul>	<ul style="list-style-type: none"> <li>Overall adjusted VE was estimated to be 24.9% in preventing laboratory-confirmed A(H3N2) influenza hospitalization</li> </ul>
Thompson, 2013 <sup>37</sup>	<ul style="list-style-type: none"> <li>N = 630</li> <li>Patients in the United States</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>VE in preventing hospitalization associated with A(H1N1)pdm09 virus infection</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination was reported to be 50% effective in preventing hospitalization associated with A(H1N1)pdm09 virus infection</li> </ul>
Ho, 2012 <sup>38</sup>	<ul style="list-style-type: none"> <li>N = 93,049</li> <li>Patients aged ≥65</li> </ul>	<ul style="list-style-type: none"> <li>Influenza vaccination</li> </ul>	<ul style="list-style-type: none"> <li>No vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Neurological and autoimmune disorders</li> <li>One-year hospitalization rates</li> <li>In-hospital mortality rates</li> </ul>	<i>“Based on data from the one-year follow-ups among 93,049 elderly persons in Taiwan, reassuring results for selected neurological and autoimmune diseases were found among the vaccinated individuals after adjusting other factors. Influenza vaccination decreased the risk for hospitalization.”</i> <sup>38</sup>

Abbreviations: CI = confidence interval; ICU = intensive care unit; MA = meta-analysis; NR = not reported; SR = systematic review; VE = vaccine effectiveness.

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