BRIEF ARTICLE

Adult Pneumococcal Vaccinations in Thailand: A Call to Action for Better Protection

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ABSTRACT

Background: Pneumococcal diseases caused by *Streptococcus pneumoniae* remain a global public health challenge, especially among young children and older adults. In Thailand, the burden of pneumococcal diseases persists due to limited vaccine uptake and the exclusion of pneumococcal vaccines from the National Immunization Program (NIP).

Objective: This narrative review aims to explore the burden and epidemiology of pneumococcal diseases among Thai adults, the impact of pneumococcal vaccination, and the cost-effectiveness of implementing pneumococcal vaccines in the Thai context.

Methods: A comprehensive review of existing literature and epidemiological data on pneumococcal disease burden, vaccine efficacy, serotype distribution, and economic evaluations was conducted.

Findings: Pneumococcal pneumonia and invasive pneumococcal diseases (IPD) remain underreported in Thailand due to limitations in surveillance and data collection. Nasopharyngeal carriage, a prerequisite for pneumococcal diseases, is prevalent among high-risk adults, with non-vaccine serotypes contributing significantly to disease burden. Vaccination programs in high-income countries demonstrate substantial reductions in disease incidence through direct and indirect (herd) effects. However, Thailand lacks a robust system for serotype surveillance and routine vaccination coverage. Recent economic analyses suggest that PCV13 is more cost-effective than PPSV23 for Thai older adults, with incremental cost-effectiveness ratios (ICERs) of 233.63 USD/QALY for healthy individuals and 627.24 USD/QALY for immunocompromised individuals. Despite higher-valency vaccines such as PCV15 and PCV20 offering broader serotype coverage, their implementation in Thailand requires further economic evaluation and price negotiations.

Conclusion: Inclusion of PCV13 in the Thai NIP for children and adults could significantly reduce the pneumococcal disease burden and offer cost-effective solutions. Prioritizing serotype surveillance, real-world vaccine effectiveness studies, and price negotiations are essential for informed decision-making in Thailand's pneumococcal vaccination strategy.

INTRODUCTION

Pneumococcal diseases, caused by *Streptococcus pneumoniae* infections, remain a significant global public health challenge, causing substantial morbidity and mortality, particularly among vulnerable populations such as young children and older adults. The clinical manifestations are classified into local infections (Pneumococcal Diseases; PD), such as acute otitis media or pneumonia and invasive pneumococcal diseases (IPD), which refers to meningitis or bacteremia. Either PD or IPD is preceded by asymptomatic nasopharyngeal colonization, particularly in children1. Therefore, carriage elimination is crucial for disease control[1]. Furthermore, carriage data represent an indirect post-deployment effect of pneumococcal vaccination[2]. In 2021, *Streptococcus pneumoniae* accounted for the highest proportion of lower respiratory tract infection (LRTI)-related deaths across all age groups, with an estimated 505,000 fatalities globally[3]. Among these, 139,000 deaths representing 27.5%, occurred in children under five years of age, while 219,000 deaths, or 43.4%, were found in adults over 70 years old[3].

The introduction of pneumococcal conjugate vaccines (PCVs) since the 2000s has significantly reduced the incidence of pneumococcal diseases across all age groups in many countries[4]. Recently, higher-valency PCVs, such as PCV15 and PCV20, have been introduced for adult immunization in high-income countries, further enhancing disease prevention efforts[5]. However, as of 2025, Thailand has yet to include any pneumococcal vaccines in its National Immunization Program (NIP)[6]. Consequently, all Thai individuals must bear out-of-pocket expenses for vaccination as an optional vaccine. This lack of inclusion in the NIP contributes to low vaccine uptake[7]and a persistently high disease burden in the country. Only 5% of patients had documented evidence of receiving a pneumococcal vaccine[8]. This narrative review provides a comprehensive examination of pneumococcal diseases among adults, with a focus on the disease burden and epidemiology, challenges and strategies for disease control through vaccination, specifically within the context of Thailand.

Thailand epidemiology and disease burden

In Thailand, the highest incidence of IPD has been observed in young children (8.8–12.3 per 100,000 individuals) and older adults (26 per 100,000 individuals), a pattern consistent with pre-vaccine distribution data reported in many other countries[9]. The annual incidence of hospitalizations due to pneumococcal pneumonia (PP) in adults was 30.5 cases per 100,000 person-years, with the highest rates observed in adults aged ≥70 years (150 per 100,000 person-years)[10]. However, these incidence rates likely underestimate the true burden of pneumococcal diseases in Thailand due to several factors, including limited hospital data input, widespread antibiotic use prior to testing, and the exclusion of cases managed in outpatient settings[11, 12]. Additionally, the absence of a robust surveillance

system capable of continuously monitoring disease trends and correcting data further exacerbates the underestimation of the burden. In addition to the paucity of local data, policymakers must weigh the benefits of PCVs against other competing vaccine priorities, contributing to the postponement of PCV introduction into the NIP.

Nasopharyngeal carriage is a precursor

Nasopharyngeal carriage is recognized as a prerequisite for pneumococcal disease, with colonization rates in children reported to range from 26.7% to 90.7%[13]. Among high-risk adults, the carriage rate has been observed to reach 20%[14, 15] or even 32.9%–41.7%[16] in certain studies. In a study of high-risk Thai adults, a notably high pneumococcal carriage prevalence of 30.8% was identified using molecular methods[17]. The most frequently detected serotypes were 19B/C (35.5%), followed by 6A/B/C/D (10.7%), with the majority being non-vaccine types[17]. It is important to note that the methods employed for detecting nasopharyngeal carriage varied across studies, potentially influencing the reported rates. These methodological differences necessitate cautious interpretation of the results. Also, the authors recommend implementing robust study designs to establish a causal link between serotype-specific nasal carriage and IPD.

Pneumococcal vaccination and recommendations

Pneumococcal vaccine has direct impacts on incidence of IPD reduction and nasal carriage elimination. The rate of pneumonia and IPD have been declined by carriage reduction[18]. Not only vaccinated children had benefit, but also unvaccinated adults had indirect effect or herd effect from pneumococcal vaccine in children. After the introduction of conjugate vaccines (PCV7 in 2000 and PCV13 in 2010) for children, trends in IPD declined not only among children but also among adults[19, 20]. The overall IPD incidence in adults 19-64 years old reduced from 16 cases per 100,000 in 1998 to 8 cases per 100,000 in 2016. Likewise, among adults more than 65 years old, the overall incidence gradually declined from 61 cases per 100,000 in 1998 to 24 cases per 100,000 in 2016[15,16]. However, these effects were observed only in PCV13 serotype diseases and countries with high vaccine coverage, with such vaccines in the NIP. Low or no data about vaccine uptake are mostly observed in Asia, in comparison to other continents[21, 22]. Therefore, those effects might be different country by country.

Pneumococcal vaccine is categorized by included pneumococcal serotype. First pneumococcal vaccine, a 23-valent pneumococcal polysaccharide vaccine (PPSV23), was introduced in early 1980s. The vaccine was intended to be provided to people aged ≥ 2 years old with medical conditions, and all people aged ≥ 65 years. In 2000, the first 7-valent conjugate pneumococcal vaccine (PCV7) was developed and implemented in the childhood immunization program, then was substituted by a 10-valent conjugate pneumococcal vaccine (PCV10), or a 13-valent conjugate pneumococcal vaccine (PCV13) in 2010, depending on individual countries/regions[23].

Currently, five types of pneumococcal vaccines are licensed for adults: PCV13, PCV15, PCV20, PCV21, and PPSV23. However, as of January 2025, only four of these—PCV13, PCV15, PCV20, and PPSV23—are licensed for use in Thai adults. PCV13, PCV15, and PCV20 were licensed for Thai adults in 2013, 2023, and 2024, respectively. PPSV23 includes a broader range of pneumococcal serotypes than PCV13. Still, conjugate vaccines consist of a carrier protein that induces a T-cell dependent immune response, that shows better

immunologic response than PPSV23[1]. A summary of included serotypes and licensed vaccine are shown in **Figure 1.**

As of October 2024, the Advisory Committee on Immunization Practices (ACIP) guidelines[24] recommend a single dose of either PCV21, PCV20, or PCV15 followed by PPSV23 for adults aged ≥50 years or adults aged 19–49 years with immunocompromising conditions, cerebrospinal fluid (CSF) leaks, or cochlear implants who have not previously received any use "PCV" instead, or have only received PCV7. For individuals previously vaccinated with PCV13 but who did not complete the recommended series, ACIP advises completing the series with either PCV20 or PCV21 instead of PPSV23. ACIP does not preferentially endorse any specific PCV. In comparison, the Infectious Disease Association of Thailand (IDAT) 2025[25] recommends either a single dose of PCV20 or sequential administration of PCV13 or PCV15 followed by PPSV23 (or PCV20) for adults aged ≥65 years, and adults aged 19–64 years with chronic health conditions, immunocompromising conditions, CSF leaks, or cochlear implants who have not previously received a PCV. In these days, PCV21 is not applicable in Thailand, as the serotypes it contains do not represent the common causes of IPD in the Thai population[26]. Therefore, PCV21 should only be considered as a sequential or booster dose for Thai adults who have previously completed vaccination with PCV13, PCV15, or PCV20.

Pneumococcal vaccine efficacy or effectiveness: The efficacy of a vaccine depends on the type of vaccine and clinical manifestation. The Community-Acquired Pneumonia Immunization Trial in Adults (CAPiTA)[27] showed that PCV13 had a vaccine efficacy of 45.6% (95.2% CI, 21.8 to 62.5) against the first episodes of vaccine-type pneumococcal community-acquired pneumonia (CAP), 45.0% (95.2% CI, 14.2 to 65.3) against nonbacteremic and noninvasive pneumococcal CAP, and 75.0% (95% CI, 41.4 to 90.8) against invasive pneumococcal disease. In summary for IPD, the efficacy of PCV13 on IPD at the first episode is about 73% and 76%, respectively[18, 27]. Meanwhile, the efficacy of PCV13 against pneumonia ranges from 43-64%[18, 27].

Several cohort and case-control studies have evaluated the vaccine effectiveness (VE) of PCV13 in older adults. In Spain, Vila-Córcoles et al[28]. reported a negative vaccine effectiveness of -52% (95% CI: -97 to -17) against pneumococcal pneumonia among adults aged ≥50 years over a 5-year period. In the U.S., Lewnard et al[29]. found adjusted VEs of 9.9% (95% CI: 1.1 to 17.9) and 8.8% (95% CI: -0.2 to 17.0) against medically attended pneumonia and all-cause pneumonia,

	1	3	4	5	6A	6B	7F	9V	14	18C	19A	19F	23F	22F	33F	8x	10A	11A	12F	15B	2	9N	17F	20	15A	15C	16F	23A	23B	24F	31	35B
PCV13																																
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PPSV23																																

Abbreviations: PCV, pneumococcal conjugate vaccine; PCV13, 13-valent PCV; PCV15, 15-valent PCV; PCV20, 20-valent PCV; PCV21, 21-valent PCV (CAPVAXIVE™, Merck); PPSV23, 23-valent pneumococcal polysaccharide vaccine.

Figure 1 Current adult licensed pneumococcal vaccines and included serotype[24]

respectively, among adults ≥65 years in a setting with 43–49% PCV13 coverage. Test-negative design studies showed more favorable results: McLaughlin et al[30]., reported a VE of 72.8% (95% CI: 12.8 to 91.5) against hospitalized vaccine-type CAP (VT-CAP), while Prato et al[31]., observed lower and inconclusive VEs of 33.2% and 38.1% against pneumococcal CAP and VT-CAP, respectively. Although PCV13 has been licensed in Thailand since 2013, its effectiveness among the targeted Thai populations remains uncertain.

The clinical studies supporting the approval of PCV15 and PCV20 in older adults are primarily based on safety and immunogenicity data[32-37]. Large head-to-head trials with invasive pneumococcal disease outcomes are unfeasible[38], leaving uncertainty about whether one vaccine is consistently more immunogenic or if immunogenicity differences lead to clinically significant protection[39]. A pivotal phase 3 trial showed that PCV20 immune response was noninferior to PCV13 for the 13 shared serotypes, and to PPSV23 for 6 of the 7 additional serotypes, demonstrating strong immune responses and a safety profile similar to PCV13[35, 36, 40]. PCV15 induces serotype-specific IgG geometric mean concentrations (GMCs) and opsonophagocytic activity (OPA) geometric mean titers (GMTs) that are comparable to those induced by PCV13 for the shared serotypes, and higher responses for the additional serotypes 22F and 33F[32-34]. For certain serotypes, such as 3 and 23F, PCV15 demonstrated a superior immune response compared to PCV13. These findings suggest that PCV15 could potentially address the protection gaps not covered by PCV13[41, 42]. Although PCV15 generates higher antibody levels for certain serotypes compared to PCV13, its clinical effectiveness remains uncertain. Continued surveillance and real-world studies are essential to evaluate the clinical impact of both vaccines on residual vaccine-type pneumococcal disease.

Cost effectiveness studies of PCV from the Thai societal perspectives

Economic studies have demonstrated that both PCV13 and PPSV23 are cost-effective for older adults. Igarashi et al. analyzed their cost-effectiveness in Japanese adults aged ≥60 years, concluding that PCV13 is more cost-effective than PPSV23[43]. In contrast, a study from Denmark found that a PPSV23 vaccination program for adults aged ≥65 years is cost-effective[44]. While numerous economic evaluations exist across different countries, their generalizability is limited by variations in pneumococcal serotype distributions and the extent of vaccine support from non-profit organizations. Recent discussions about including pneumococcal vaccines in the Thai NIP highlight the need to balance costs and benefits. Current economic evaluations in Thailand are primarily focused on pediatric populations and yield conflicting results. Studies from the Philippines and Singapore found pneumococcal vaccine implementation cost-effective compared to no vaccination[45, 46]. However, Thai studies have varied outcomes; in 2013, Kulpeng et al.[47] reported that the 10-valent pneumococcal polysaccharide nontypeable Haemophilus influenzae protein D-conjugated vaccine (PHiD-CV) and PCV13 were not cost-effective due to high costs, while in 2019, Dilokthornsakul et al.[48] demonstrated that incorporating herd immunity made both vaccines cost-effective for children. Recent economic evaluations specifically targeting Thai older adults found that PCV13 is more cost-effective than PPSV23 for Thai older adults, with an incremental cost-effectiveness ratio (ICER) of 233.63 USD/QALY for healthy individuals, and 627.24 USD/

QALY for immunocompromised individuals; therefore, PCV13 should be prioritized in the NIP as it provides better health outcomes and is more economical compared to PPSV23 and no vaccination[7]. The authors recommend that price negotiations with manufacturers are endorsed to reduce the cost of vaccines and achieve cost-saving results.

Individualized decision-making for pneumococcal vaccination in Thai adults

The current evidence for higher valency pneumococcal vaccines, specifically PCV15 and PCV20, offer significant advantages for older adults in terms of broader serotype coverage and potential reduction in IPD beyond what is achieved with PCV13. PCV15 includes two additional serotypes (22F and 33F) not present in PCV13, while PCV20 covers seven additional serotypes (8, 10A, 11A, 12F, 15B, 22F, and 33F)[49, 50]. A study on IPD serotype distribution in older adults from high-income countries found that PCV15 and PCV20 could cover an additional 10.4% and 32.9% of IPD cases, respectively, beyond the coverage of PCV13[51]. These findings suggest that higher-valency vaccines could potentially reduce the residual IPD burden in older adults[51].

In Thailand, the absence of a serotype distribution surveillance system and routine serotype testing for culture-confirmed *Streptococcus pneumoniae* cases hinders the accurate identification of serotype-specific causes of IPD and pneumonia. The longitudinal data between 2012 and 2016 in central Thailand regarding the serotype distribution found that the most common serotypes at all ages were 6B (17.4%), 19A (13.0%), and 14 (11.2%), respectively. All of these are covered by PCV13 or PCV15; meanwhile, non-PCV15 serotypes were detected in 27.9%; the most common serotypes were 15B/C (5.1%), 15A/F (4.0%), and 23A (3.6%)[26].

The authors suggest that a single dose of PCV13 provides adequate serotype coverage for all adults. Additionally, they strongly recommend the inclusion of PCV13 in the Thai NIP for children, as this would not only reduce the disease burden among children but also provide indirect protection for adults through herd immunity. While higher-valency PCVs offer broader serotype coverage, their additional benefits should be carefully weighed against the marginal reduction in disease burden and associated costs. Comprehensive economic analyses are essential before considering the inclusion of higher-valency PCVs in the NIP within the context of Thailand.

Individualized decision-making regarding current PCV recommendations within the context of Thailand are summarized in **Table 1**

CONCLUSIONS

Pneumococcal diseases continue to impose a significant public health burden in Thailand, particularly among older adults and high-risk populations. Despite the proven efficacy of PCVs in reducing IPD and pneumonia globally, their exclusion from Thailand's NIP limits vaccine uptake and leaves the population vulnerable to preventable morbidity and mortality. Current evidence highlights the cost-effectiveness of PCV13 compared to PPSV23 for Thai older adults. Thailand must prioritize robust serotype surveillance, real-world vaccine effectiveness studies, and negotiations with vaccine manufacturers to reduce costs. Including PCV13 in the NIP, particularly for children, and this would not only benefit this age group but also provide significant herd immunity effects for adults, thereby reducing the overall pneumococcal disease

Table 1 Individualized decision-making for pneumococcal vaccination in Thai adults[52]

Questions	Considerations	Authors' Perspectives
Who should receive a pneumococcal vaccine?	**Age based approach:** ≥50 or ≥65 years **Risk based approach:** chronic health and immunocompromised conditions	• Age-stratified data on IPD and pneumococcal pneumonia in Thailand will help determine whether the age threshold for vaccination should be set at 50 or 65 years. • The risk-based approach aligns closely with ACIP/IDAT recommendations[24, 25].
Which vaccine should be used?	Immunogenicity Clinical efficacy Mucosal immunity Indirect effect Herd protection	• PCV is preferable to PPSV due to its higher immunogenicity, mucosal immunity, demonstrated clinical efficacy and effectiveness, and strong evidence of herd protection. • Based on serotype distribution of IPD in Thailand, the majority of IPD-causing serotypes are covered by PCV13 or PCV15[26] • PCV13 is cost-effective from a Thai societal perspective[7]. • PCV15 has demonstrated stronger immunogenicity compared to PCV13[41]. • Cost-effectiveness studies of PCV15 and PCV20 are currently underway.
Should pneumococcal vaccination be repeated?	Waning immunity Replacement strains	• Waning immunity is expected, particularly among immunocompromised individuals. • PCV13 vaccine effectiveness appears to be sustained for at least four years post-vaccination[53]. • A single booster dose of PCV20 or PCV21 may be considered following primary vaccination with PCV13 or PCV15[24]. • PCV21 is not recommended for primary immunization in Thailand, as its included serotypes do not represent the predominant causes of IPD in the Thai population.

burden in the country. Ultimately, a strategic and evidence-based approach to pneumococcal vaccination could lead to substantial public health improvements and align Thailand with global efforts to control pneumococcal diseases.

Potential Conflicts of Interest

The authors declare no conflict of interest.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT 4o version in order to assist with English editing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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