

# Pneumococcal Serotype Distribution: Recent Data in Pediatric Populations Around the World, 2017–2019

## BACKGROUND AND AIMS

- Despite broad availability of pneumococcal vaccines (pneumococcal polysaccharide (PPV23) and pneumococcal conjugate vaccines (PCVs)), pneumococcal disease continues to be a global health problem
- A comprehensive review and synthesis of the literature was undertaken to illustrate recent changes in pediatric serotype distribution and emergence of new disease-causing serotypes that are not covered by current vaccines

## METHODS

- Medline, EMBASE and Cochrane were searched from February 2017 to May 2019
- Search terms were serotype, serogroup, pneumococc\*, *Streptococcus pneumoniae*. Studies with N<100 or those including data prior to 2012 were excluded
- Reported serotype distribution data for children ≤5 years were extracted and summarized
- Serotype prevalence was calculated from pooled data, globally, by WHO region and by disease type (invasive pneumococcal disease (IPD) vs non-IPD) with vaccine serotype distribution reported

## RESULTS

- Serotype data were available in 51 articles: nasopharyngeal carriage (NPC) (n=30), IPD (n=21), non-IPD (n=2) and IPD/ non-IPD combined (n=3)

Table 1. Study characteristics

Region / Source	Country	Period	Pneumococcal disease type	N	Age group	Infant vaccine program*
Europe						
Darino et al. 2019 <sup>1</sup>	Israel	2012-15	NPC	2037	<5 y	PCV13
Diaz-Conrardi et al. 2019 <sup>2</sup>	Spain	2010-16	IPD	31	<2 y	PCV13
Kandasamy et al. 2019 <sup>3</sup>	United Kingdom	2014-15	NPC	482	13-48 mo	PCV13
Kent et al. 2019 <sup>4</sup>	England	2013-16	IPD	379	<5 y	PCV13
Mayansky et al. 2019 <sup>5</sup>	Russia	2012-17	NPC	543	<5 y	Pre-post-PCV13
Picazo et al. 2019 <sup>6</sup>	Spain	2015-16	IPD	42	<5 y	PCV13
Polkowska et al. 2019 <sup>7</sup>	Poland	2012-15	IPD	44	<5 y	NS
Richter et al. 2019 <sup>8</sup>	Austria	2013-16	IPD	36	<5 y	PCV10
Silva-Costa et al. 2019 <sup>9</sup>	Portugal	2012-15	IPD	64	0-11 mo	PCV13
Wouters et al. 2019 <sup>10</sup>	Belgium	2016-17	NPC	72	2-4 y	PCV13
Abu Seir et al. 2018 <sup>11</sup>	Israel	2014	NPC (E. Jerusalem)	827	6-30 mo	PCV13
Ben-Shimol et al. 2018 <sup>12</sup>	Israel	2012-16	IPD	88	<5 y	PCV10
Ladhani et al. 2018 <sup>13</sup>	England and Wales	2016-17	IPD	184	<5 y	PCV13
Lataisa Zamaïlova et al. 2018 <sup>14</sup>	Spain	2013-15	IPD	331	<5 y	PCV13
Makwana et al. 2018 <sup>15</sup>	England and Wales	2015-16	IPD	177	<5 y	PCV13
Quirk et al. 2018 <sup>16</sup>	Iceland	2012-17	NPC	232	3-59 mo	PCV13
Rybak et al. 2018 <sup>17</sup>	France	2013-16	IPD	54	1 y	PCV10
Southern et al. 2018 <sup>18</sup>	England	2012-13	NPC	911	2-3 y	PCV10
Visser et al. 2018 <sup>19</sup>	Netherlands	2015-16	IPD	273	<2 y	PCV13
Wouters et al. 2018 <sup>20</sup>	Belgium	2015-16	NPC	128	2-3 y	PCV13
Dominguez et al. 2017 <sup>21</sup>	Spain	2012-16	IPD	1994	6-24 mo	PCV13
Protasova et al. 2017 <sup>22</sup>	Russia	2013	IPD	208	<5 y	PCV13
Supersison et al. 2017 <sup>23</sup>	Iceland	2013-15	IPD	130	<5 y	PCV13
Asia Pacific						
Anushahy et al. 2019 <sup>24</sup>	Malaysia	2014-17	IPD	152	<5 y	PCV13
Lu et al. 2019 <sup>25</sup>	Taiwan	2012-17	IPD	628	<5 y	PCV13
Satzke et al. 2019 <sup>26</sup>	Laos	2013-16	NPC	151	5-8 wk	PCV13
Shi et al. 2019 <sup>27</sup>	China	2012-17	IPD	588	12-23 mo	PCV13
Dunne et al. 2018 <sup>28</sup>	Indonesia	2016	NPC	64	<2 y	Pre-PCV13
Dunne et al. 2018 <sup>29</sup>	Fiji	2012-15	NPC	40	3-5 y	Pre-PCV13
Li et al. 2018 <sup>30</sup>	China	2015-17	IPD and non-IPD	164	12-24 mo	Pre-PCV
Shen et al. 2017 <sup>31</sup>	China	2014-16	IPD and non-IPD	1957	5-8 wk	PCV10
North America						
De Waile et al. 2018 <sup>32</sup>	Canada	2012-16	IPD	537	12-23 mo	Pre-PCV
Latin America						
Brandileone et al. 2018 <sup>33</sup>	Brazil	2014-15	IPD	419	<2 y	Pre-PCV
Neves et al. 2018 <sup>34</sup>	Brazil	2014	IPD	247	2 mo-4 y	PCV10
Toledo et al. 2017 <sup>35</sup>	Cuba	2013	NPC	131	<6 y	PCV10/PCV13
African/Eastern Mediterranean						
Emgard et al. 2019 <sup>36</sup>	Tanzania	2013-15	NPC	212	2-18 mo	Pre-PCV
Hammit et al. 2019 <sup>37</sup>	Kenya	2012-16	IPD	194	<2 y	PCV13
Maranzhe et al. 2019 <sup>38</sup>	South Africa	2012-14	NPC	34	<5 y	PCV10
Usuf et al. 2019 <sup>39</sup>	Gambia	2014-16	NPC	606	<1 y	PCV13
Adenomon et al. 2018 <sup>40</sup>	Mozambique	2014-16	NPC	780	6-12 mo	PCV13
Birindwa et al. 2018 <sup>41</sup>	Democratic Republic of the Congo	2014-15	NPC	301	<5 y	PCV10
Boschi et al. 2018 <sup>42</sup>	Ghana	2015-17	IPD	1480	1-60 mo	PCV13
Dube et al. 2018 <sup>43</sup>	South Africa	2012-14	IPD	4	<5 y	PCV13
Kamrè et al. 2018 <sup>44</sup>	Burkina Faso	2014-15	IPD	141	s1 y	PCV13
Nisar et al. 2018 <sup>45</sup>	Pakistan	2013	NPC	1667	<5 y	Pre-PCV10
Usuf et al. 2018 <sup>46</sup>	Gambia	2013-14	IPD	173	<5 y	PCV13
Verani et al. 2019 <sup>47</sup>	Mozambique	2010-13	NPC (HIV-negative)	341	3-11 mo	Pre-PCV10
Badawy et al. 2017 <sup>48</sup>	Egypt	2012-14	NPC (HIV-positive)	176	12-59 mo	Pre-PCV13
Ktari et al. 2017 <sup>49</sup>	Tunisia	2012-16	IPD and non-IPD	374	<5 y	Pre-PCV
Nackers et al. 2017 <sup>50</sup>	Uganda	2014	NPC	246	<5 y	Pre-PCV
Zabihullah et al. 2017 <sup>51</sup>	Afghanistan	2012-13	NPC	339	6 mo-4 y	Pre-PCV**
				113	<5 y	Pre-PCV**
				114	<5 y	Pre-PCV**
				201	<2 y	Pre-PCV
				154	2-4 y	Pre-PCV
				110	<5 y	Pre-PCV

IPD: invasive pneumococcal disease; mo: months; NPC: nasopharyngeal carriage; NS: not specified; PCV: pneumococcal conjugate vaccine; wk: weeks; y: years

\*Infant vaccine program in place during data collection; \*\*Post-PCV13 only in the private sector

- Globally and by region, prevalence of serotypes either carried or causing any disease are shown in **Figure 1**
  - Globally, the most prevalent PPV23-unique serotypes were 15B/C (7.1 %), 11A (3.2%), and 10A (2.3%). The most prevalent PCV7 serotypes were 19F (5.6%) and 23F (3.0%). The most prevalent unique PCV13 serotypes were 19A (5.1%) and 6A (2.9%)
  - The most commonly reported serotypes varied by region. Non-vaccine serotypes were highly prevalent in the African/Eastern Mediterranean and European regions
  - Among vaccine serotypes:
    - PPV23 unique serotypes were most prominent in Europe and the African/Eastern Mediterranean region
    - PCV7 serotypes were most prominent in the Asia Pacific and African/Eastern Mediterranean regions
    - PCV13 unique serotypes were most prominent in Latin America and North America

- Figure 2** illustrates differences in serotype distribution between populations with IPD and those reporting carriage or non-IPD
  - Globally, PCV7 serotypes accounted for 10% of the IPD cases reported, led by serotypes 14 (3.1%) and 19F (2.4%); PCV13 (all 13 serotypes) accounted for 32% of IPD cases, led by serotypes 19A (8.2%) and 3 (5.0%)
  - PPV23-specific serotypes were more common among the IPD reports, with serotypes 12F and 15B/C accounting for 8.2% and 4.4%, respectively
  - Non-vaccine and PCV7 serotypes were more common among the NPC reports than the IPD reports. In the two non-IPD studies, PCV7 serotypes were more common than the IPD or NPC studies

Figure 1. Pooled pneumococcal serotype distribution globally and by region among children ≤5 years of age<sup>a</sup>

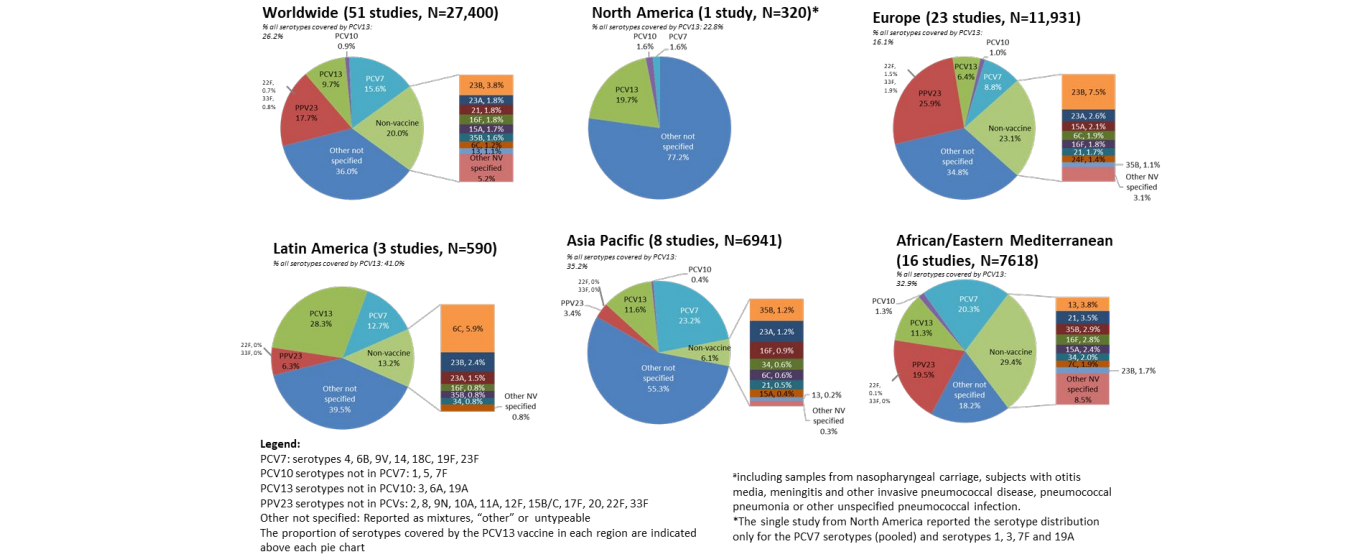
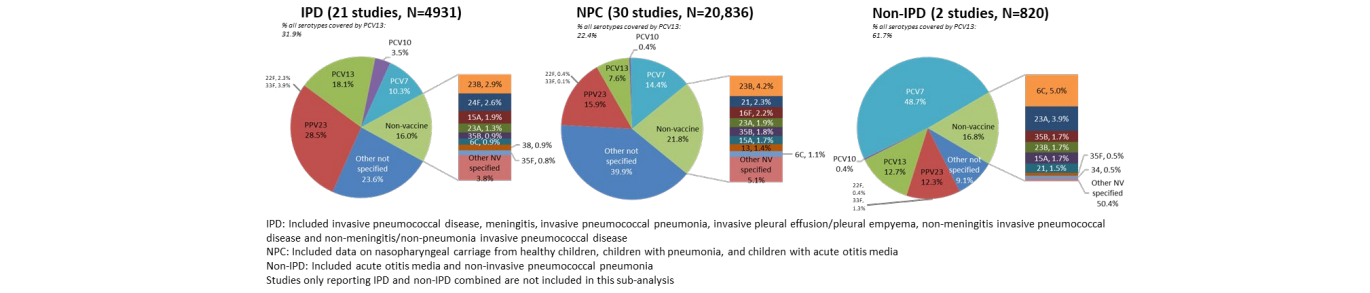
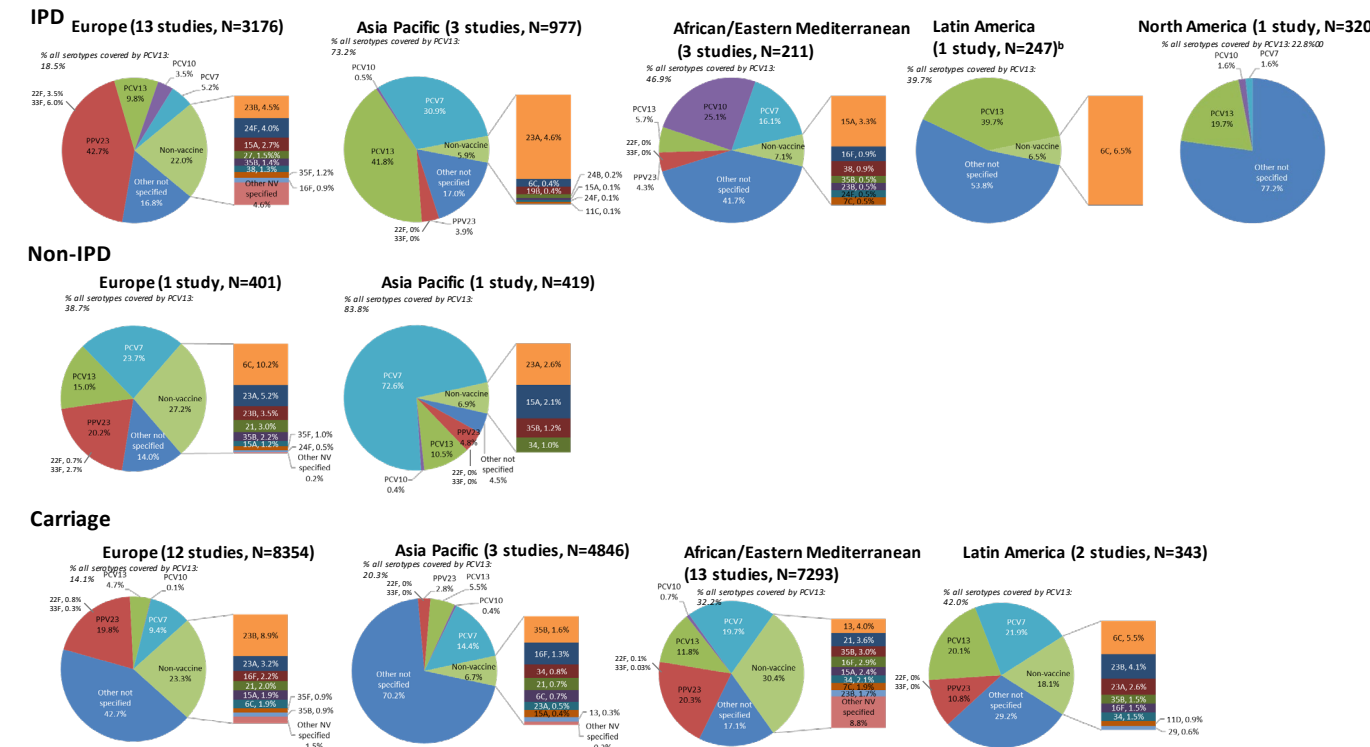


Figure 2. Pooled pneumococcal serotype distribution among children ≤5 years of age with or without IPD



- Differences in serotype distribution between populations with IPD, non-IPD, and carriage are displayed by region in **Figure 3**
  - In all regions (except Latin America) where data is available, PCV13-type serotypes (all 13) were more common in studies reporting IPD, led by serotype 19A except in Europe (serotype 3) and Latin America (serotype 1), than in those reporting carriage
  - Prevalence of PPV23-specific serotypes between IPD and carriage/non-IPD reports varied by region: Europe had higher prevalence among IPD reports and the African/Eastern Mediterranean region had higher prevalence among the carriage reports
  - Non-vaccine serotypes were more common among the carriage reports than IPD reports in African/Eastern Mediterranean and Latin American regions

Figure 3. Pooled pneumococcal serotype distribution among children ≤5 years of age with or without IPD by region



IPD: Invasive pneumococcal disease, meningitis, invasive pneumococcal pneumonia, invasive pleural effusion/pleural empyema, non-meningitis invasive pneumococcal disease and non-meningitis/non-pneumonia invasive pneumococcal disease  
NPC: Included data on nasopharyngeal carriage from healthy children, children with pneumonia, and children with acute otitis media  
Non-IPD: Included acute otitis media and non-invasive pneumococcal pneumonia  
Studies only reporting IPD and non-IPD combined are not included in this sub-analysis  
a: the study from Canada reported data only for the PCV7 serotypes (pooled) and serotypes 1, 3, 7F and 19A  
b: the study from Brazil reported data only for the PCV10 serotypes (pooled) and serotypes 3, 6A, 6C and 19A

## SUMMARY/CONCLUSIONS

- Although most studies in our review came from countries with PCV vaccination, PCV serotypes were highly prevalent. PCV13 serotypes (all 13) caused 32% of IPD cases reported worldwide, with 19A and 3 as the most commonly reported
- Common serotypes causing IPD that were not covered by a currently licensed PCV were 33F, 23B, 24F and 22F
- Non-vaccine serotypes comprised a substantial proportion of reported serotypes and were slightly more frequent among carriage/non-IPD than IPD studies. Globally, the most common non-vaccine serotypes were 23B, 23A, 21, 16F
- This study was limited in that it covered various time periods from various geographic areas using data of non-uniform granularity

## References

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