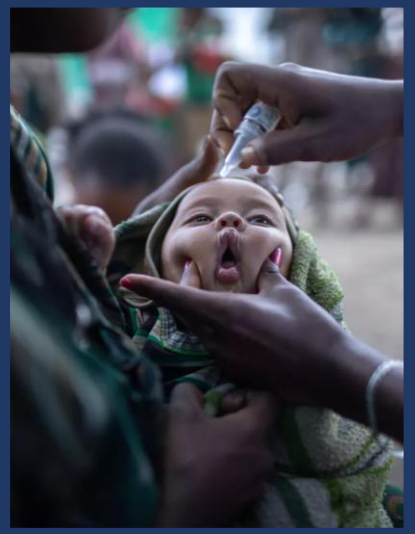





North Macedonia

Administrative Data Quality Review Report, 2025







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Administrative Data Quality Review

This report presents a systematic review of immunization administrative data quality. It is designed to support country-level data review discussions. Administrative ("admin") data can be affected by reporting errors, denominator inconsistencies, and supply disruptions. This report helps identify where data quality issues may exist and why admin coverage may diverge from the WHO/UNICEF Estimates of National Immunization Coverage (WUENIC), survey, and official government estimates.

This report covers the following data quality components:

Schedule & Supply Context

Vaccine schedule, introduction years, and recorded stockouts

Coverage Overview

WUENIC, admin, official government, and survey coverage across all vaccines and years.

Admin Coverage Flags

Years where admin coverage exceeds 100% or changes by more than ± 10 percentage points.

Admin vs. Estimates

Gaps between admin and WUENIC estimates; gaps between admin and official government estimates.

Numerator Checks

Percent change from the previous year in the number of children vaccinated; co-administration consistency checks.

Denominator Checks

Percent change from the previous year in target population size; live births vs. surviving infants over time.

Admin Data Availability Heatmap

Heatmap showing which vaccines have missing or present administrative data by year.

Admin Data Comments

Country-reported explanations for numerator accuracy, denominator source, and denominator accuracy.

Flags in this report indicate areas that warrant further review — they do not necessarily indicate errors. Country context, schedule changes, and reporting system updates should be considered alongside these findings.

The electronic Joint Reporting Form (eJRF)

Since 1998, in an effort to strengthen collaboration and minimize the reporting burden of countries, WHO and UNICEF have jointly collected immunization system and related information through a standard questionnaire (the Joint Reporting Form) sent to all Member States. In 2021, the form was updated to a cloud-based solution known as the electronic Joint Reporting Form (eJRF).

The eJRF serves three core functions:

Mission-Critical Data	Strategic Utility	Comprehensive Scope
Serves as the primary data source for tracking the **Immunization Agenda 2030 (IA2030)** and the Sustainable Development Goals (SDGs).	Informs WUENIC estimates, guides global funding decisions, and populates the UNICEF *State of the World's Children* reports.	Captures national and subnational coverage, vaccination schedules, vaccine stockouts, and disease trends.

All data in this presentation is sourced from the eJRF.

Definitions of immunization terms

Vaccine coverage
Percentage of infants (children under one year of age) who received certain vaccine-doses. For example, coverage of DTP3 is the percentage of infants who received all three doses of diphtheria, tetanus, and pertussis (DTP) vaccine.

Unvaccinated
An infant that did not receive the first dose of a vaccine series. The term zero-dose is used to describe children unvaccinated with DTP1.

Under-vaccinated
An infant who received some but not all the recommended vaccine-doses in the national schedule.

Vaccine-Doses
- Bacillus Calmette-Guerin (BCG): vaccine against tuberculosis
- Hepatitis B birth dose, given within 24 hours after birth (HepBB)
- Diphtheria, tetanus, and pertussis vaccine, first dose (DTP1) and third dose (DTP3)
- Hepatitis B vaccine, third dose (HepB3)
- Haemophilus influenzae type b vaccine, third dose (Hib3)
- Inactivated polio vaccine, first dose (IPV1) and last dose (IPVC)
- Measles containing vaccine, first dose (MCV1) and second dose (MCV2)
- Rotavirus vaccine, last dose (RotaC)
- Pneumococcal vaccine, last dose (PCVC)
- Yellow Fever vaccine (YFV)
- Meningococcal A vaccine (MengA)
- Human papillomavirus vaccine, first dose (HPV1) and last dose (HPVc): vaccine to protect against certain types of human papillomavirus that can lead to cancer or genital warts

The Immunization Agenda 2030 (IA2030)
The IA2030 is a global strategy endorsed by the World Health Assembly aiming to ensure everyone, everywhere, at every age benefits from vaccines for improved health and well-being by 2030. It focuses on increasing vaccine coverage, equity, sustainability and pandemic preparedness while promoting life-course immunization and integrating immunization with other health services.

Data Sources Presented

This report presents data from the following sources:

WUENIC	Administrative ("Admin")	Official	Survey
WHO/UNICEF Estimates of National Immunization Coverage (WUENIC) provides annual country-level immunization coverage estimates produced jointly by WHO and UNICEF. These estimates are derived from a systematic review of all available data sources and are adjusted to account for data quality issues.	Reported by national authorities and based on aggregated administrative reports from health service providers on the number of vaccinations administered during a given period (numerator) and reported target population data (denominator).	Estimated coverage reported by national authorities that reflects their assessment of the most likely coverage based on any combination of administrative coverage, survey-based estimates, or other data sources or adjustments.	Based on estimated coverage from population-based household surveys among children aged 12–23 months or 24–35 months. Survey results are considered for the appropriate birth cohort based on the period of data collection. Coverage information is based on the combination of vaccination history from documented evidence or caregiver recall.

Vaccine Schedule

		Dose number and age administered			
Level	**Vaccine**	**1**	**2**	**3**	**4**
National	BCG	Birth			
National	DTP	2 months		6 months	
National	DTAPHIBIPV		4 months		
National	DTAPHIBIPV (booster)				18 months
National	HEPB (pediatric)	Birth			
National	HPV (females)	12 years	+ 6 months		
National	HPV (females and males)	12 years	+ 6 months		
National	MCV	12 months	6 years		
National	PCV	2 months	4 months	12 months	
National	RotaC	2 months	4 months	6 months	

This table shows the 2025 national immunization schedule for routine services in North Macedonia, reported through the WUENIC Joint Reporting Form on Immunization (JRF).

Each row corresponds to a vaccine or combination vaccine, indicating whether it is delivered at the national or subnational level. The schedule outlines the number of doses and the recommended ages for administration. Only childhood and adolescent vaccines relevant to WUENIC are included.

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WUENIC 2025 revision

Vaccine Stockouts

Vaccines / supplies	2021
HPV	National (6m) and subnational
HepB	National (6m) and subnational

Years in which a national or subnational vaccine stockout was recorded.

This table provides context for interpreting the numerator and denominator trends and flags in the following slides, as stockouts may contribute to reduced service delivery and legitimate drops in coverage that may be misinterpreted as data quality issues.

Vaccine Introductions

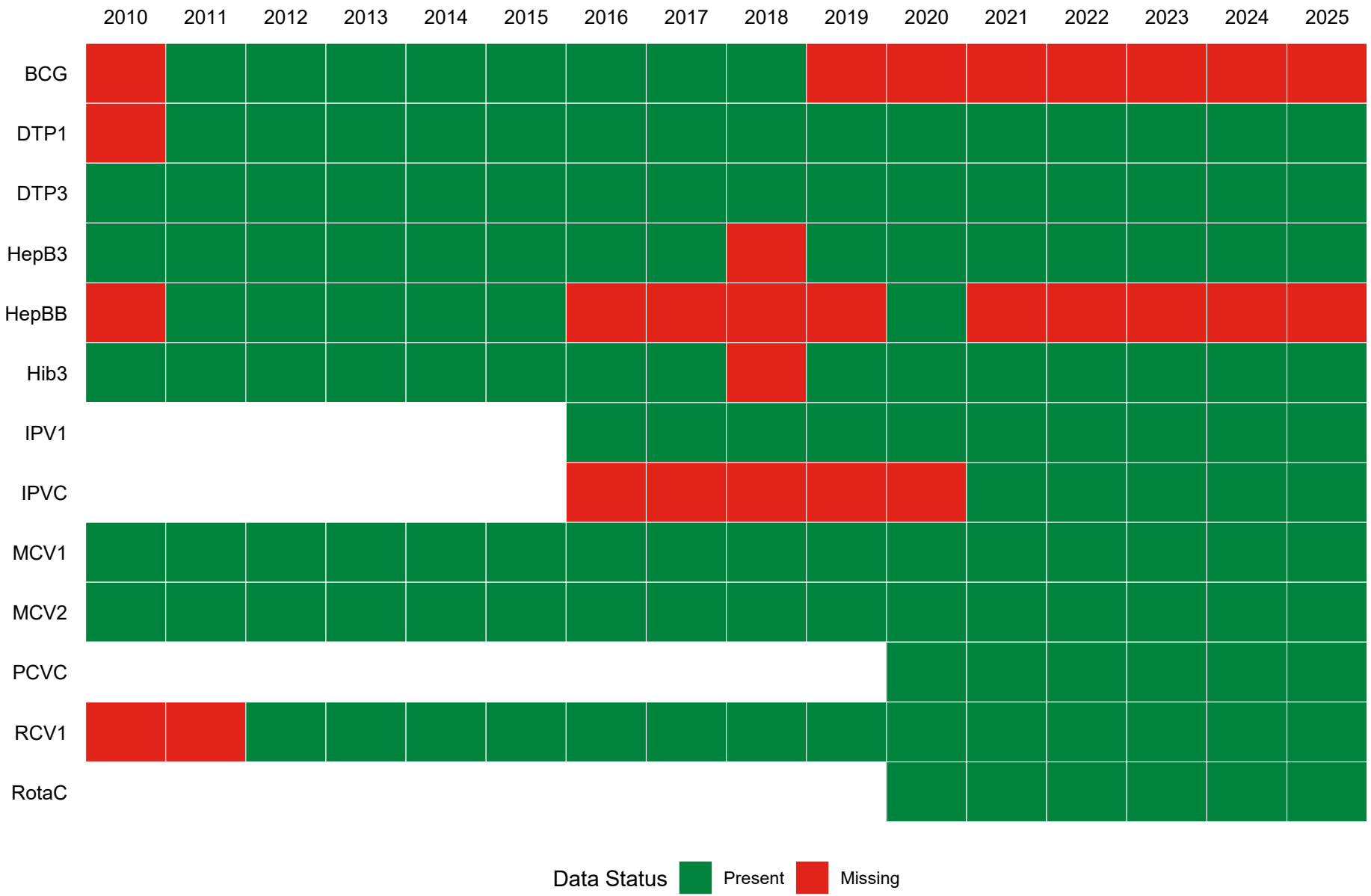
Vaccine	National introduction
HPV (Human papillomavirus) vaccine	2009
HepB birth dose	2004
Hepatitis B vaccine	2004
Hib (Haemophilus influenzae type B) vaccine	2008
IPV (Inactivated polio vaccine)	2015
IPV (Inactivated polio vaccine) 2nd dose	2015
Malaria vaccine	Not introduced
Measles-containing vaccine 2nd dose	1993
Meningococcal meningitis vaccines (any strain)	Not introduced
Mumps vaccine	1995
PCV (Pneumococcal conjugate vaccine)	2019
RSV (Respiratory syncytial virus) immunization strategy	Not introduced
Rotavirus vaccine	2019
Rubella vaccine	1993
Typhoid conjugate vaccine	Not introduced
YF (Yellow fever) vaccine	Not introduced

Year in which each vaccine was introduced nationally, partially, for risk groups, or risk areas.

We present the vaccination introductions table here to contextualize the data availability heatmap on the following slide.

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Admin Data Availability Heatmap by Vaccine, North Macedonia, 2010–2025



Heatmap showing whether admin data are present (green), missing (red), or not applicable because the vaccine had not yet been introduced or reporting had not started (white), by vaccine and year.

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WUENIC 2025 revision

Admin Data Comments Summary: 2024

Comment Type	Comment
Denominator Accuracy	Denominator bias in immunization coverage data can result from a different factors: inconsistent use of definitions of the target population, different data sources for target population, lack of data for population on displaced population out and in the country. These biases can lead to misleadingly high as well as low coverage estimates, underscoring the need for clearer definitions and improved population data systems. The denominator includes all eligible children: eligible birth cohort (or school cohort) according to the Regular Immunization Calendar as well as those eligible according to the Catch-up Calendar (older children who missed regular vaccination).
Denominator Source	For birth doses the data in denominators are obtained by the birth services, maternity hospitals or patronage nurses. For the other data in denominators are obtained by the vaccinators from vaccination points.
Numerator Accuracy	The accuracy of the numerator in immunization records collected through the administrative method is limited by several factors: inaccurate (consequence of errors in manual recording) or poor record-keeping, double counting of individuals vaccinated at multiple sites. These limitations highlights the importance of routine data quality assessments and electronic recording by using e-health system (electronic immunization register is available in the country but not fully used).

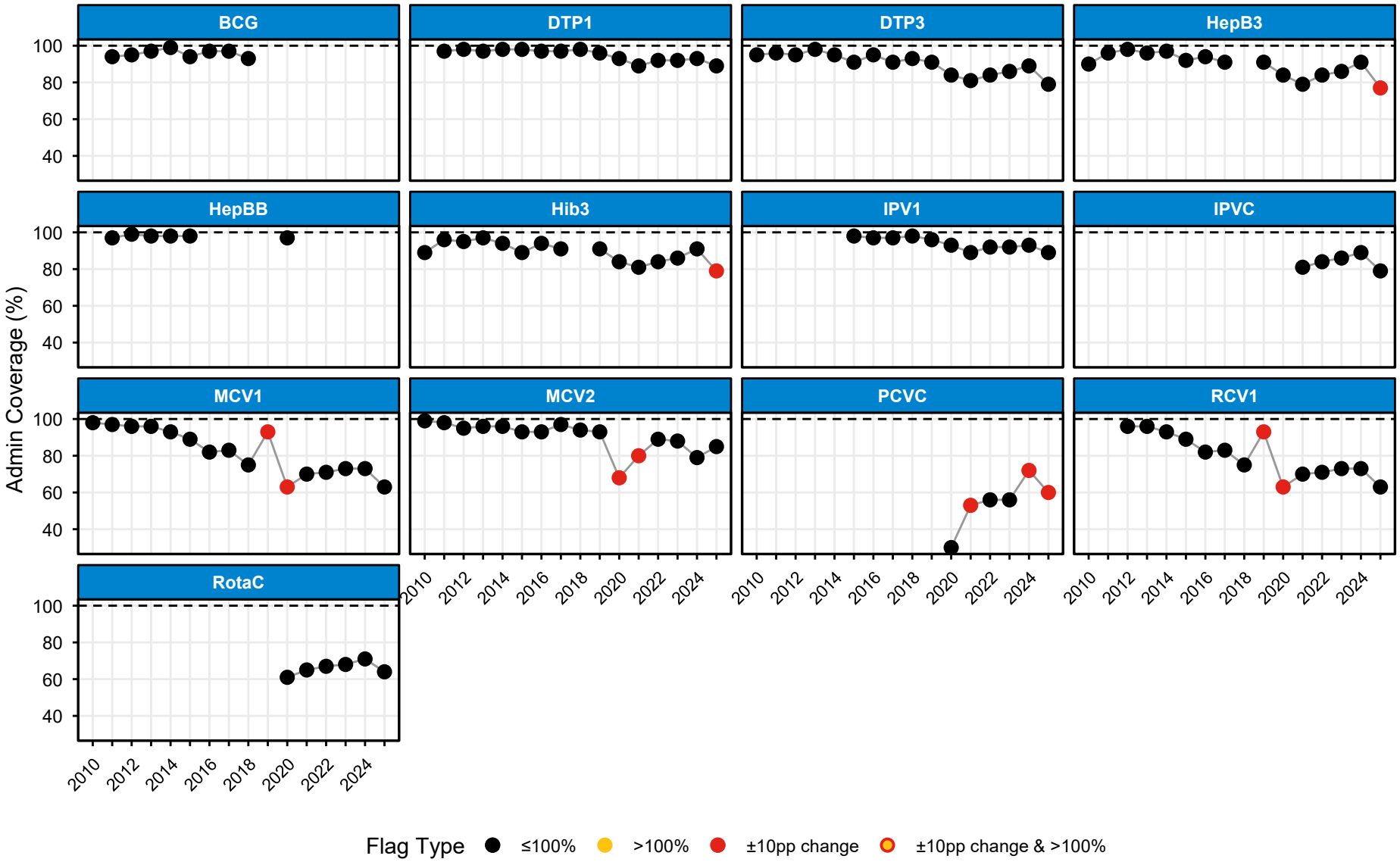
Summary of all admin data comment fields for the most recent year with available data (2024).

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Admin Coverage Flags

Admin Coverage Flags by Vaccine and Year, North Macedonia, 2010–2025

Orange = coverage > 100% | Red = ± 10pp



Flag Type ● ≤100% ● >100% ● ±10pp change ● ±10pp change & >100%

Gaps in line indicate missing admin data for that year.

Admin coverage flagged where values exceed 100% (orange) or change by more than ±10 percentage points from the previous year (red), 2010–2025.

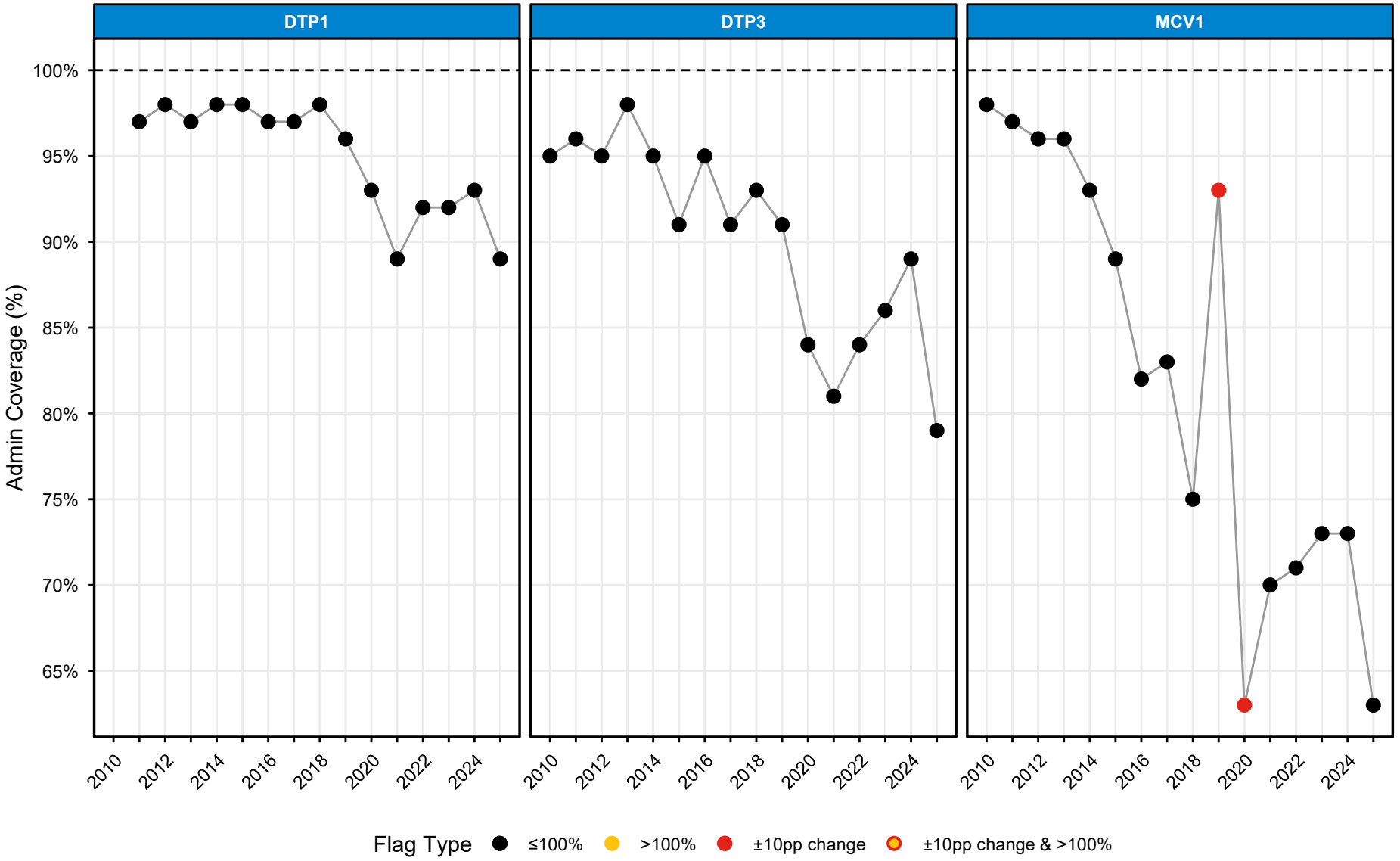
Two types of data quality issues are highlighted: coverage values above 100%, which suggest errors in the reported number of vaccinations or the denominator used, and year-on-year changes greater than 10 percentage points, which may reflect inconsistent reporting rather than true changes in vaccination coverage.

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WUENIC 2025 revision

DTP1, DTP3, and MCV1 Admin Coverage Flags by Year, North Macedonia, 2010–2025

Orange = coverage > 100% | Red = ± 10pp



Gaps in line indicate missing admin data for that year.

Same flag logic applied to DTP1, DTP3, and MCV1 only, 2010–2025.

Two types of data quality issues are highlighted: coverage values above 100%, which suggest errors in the reported number of vaccinations or the denominator used, and year-on-year changes greater than 10 percentage points, which may reflect inconsistent reporting rather than true changes in vaccination coverage.

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WUENIC 2025 revision

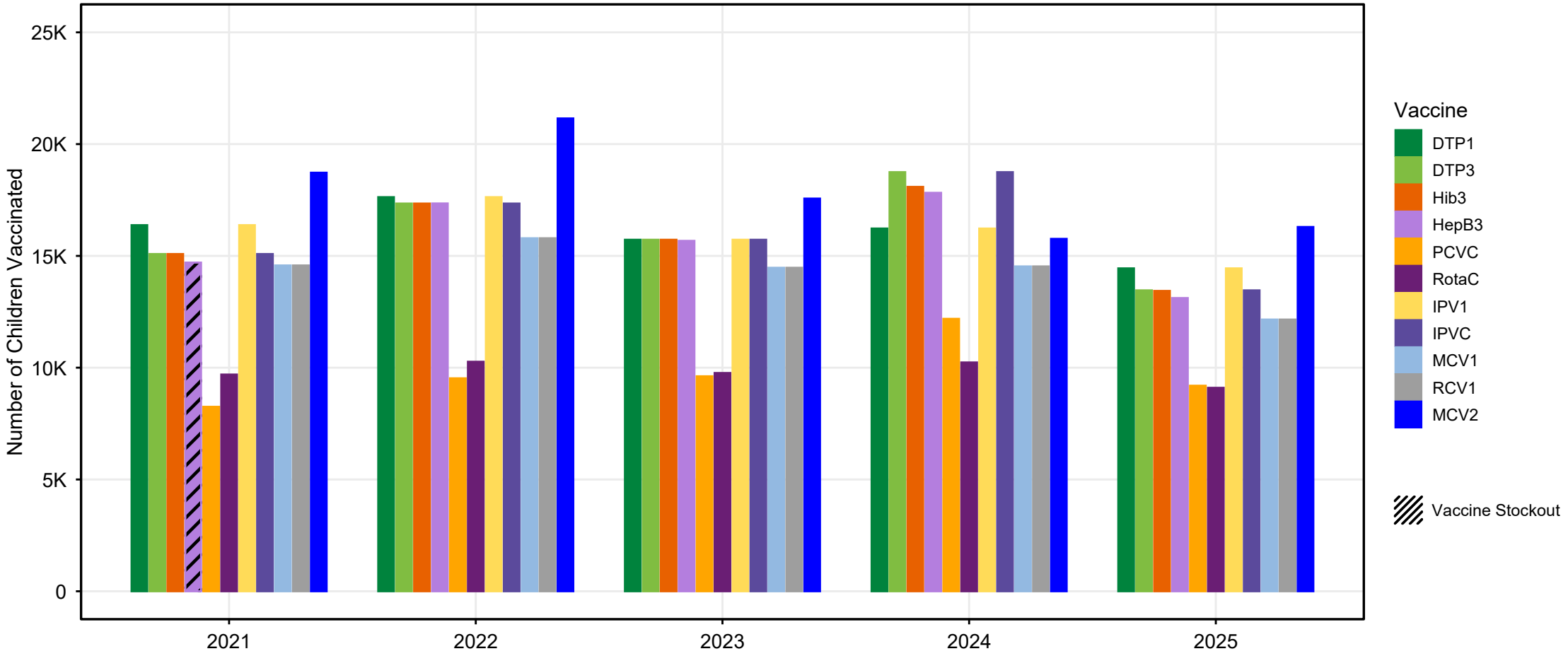
Numerator Checks

Admin Data Comments:
Numerator Accuracy (2021–2024)

Year	Comment
2024	The accuracy of the numerator in immunization records collected through the administrative method is limited by several factors: inaccurate (consequence of errors in manual recording) or poor record-keeping, double counting of individuals vaccinated at multiple sites. These limitations highlights the importance of routine data quality assessments and electronic recording by using e-health system (electronic immunization register is available in the country but not fully used).
2023	In denominator are included all children who missed the dose at recommended age
2022	In denominator are included all children who missed the dose at recommended age
2021	In denominator are included all children who missed the dose at recommended age

Factors limiting the accuracy of the numerator as reported by North Macedonia.

Number of Children Vaccinated by Vaccine and Year, North Macedonia, 2021–2025



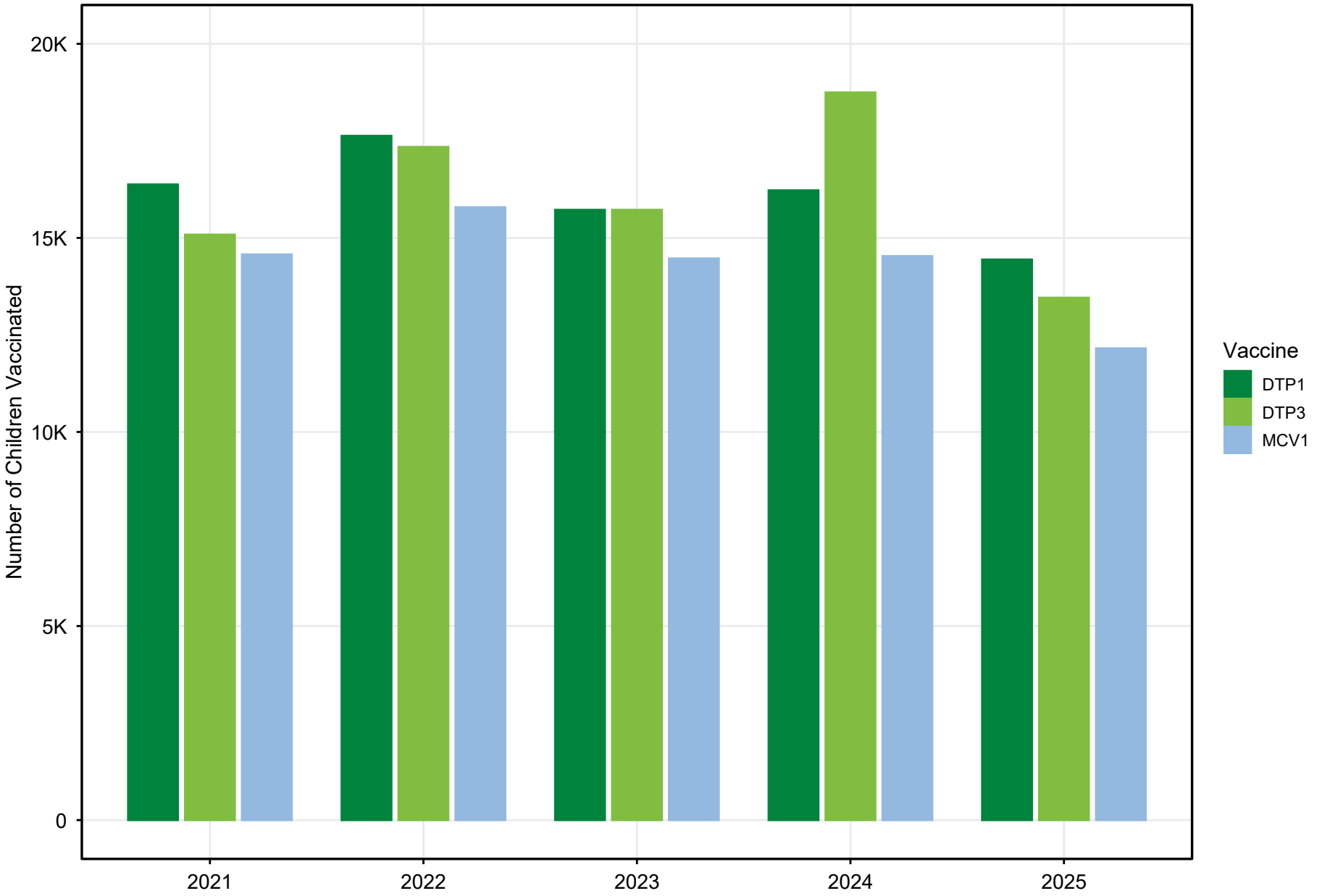
This chart shows number of children vaccinated (numerator) by vaccine and year.

Black diagonal lines indicate years with a national- or subnational-level vaccine stockout, which may explain any drops in the number of children vaccinated.

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Number of Children Vaccinated by Vaccine and Year (DTP1, DTP3, MCV1), North Macedonia, 2021–2025



Number of children vaccinated (numerator) by vaccine (DTP1, DTP3, and MCV1 only) and year.

Black diagonal lines indicate years with a vaccine stockout, which may explain any drops in the number of children vaccinated.

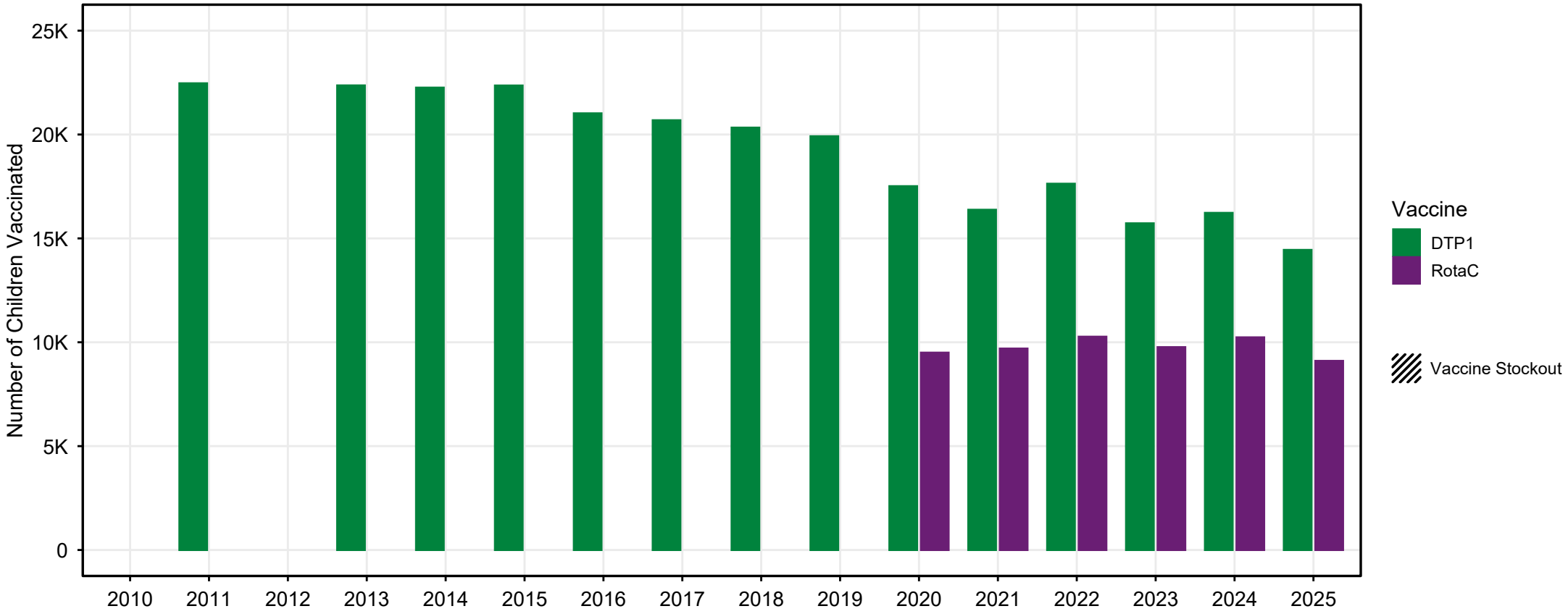
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WUENIC 2025 revision

Number of Children Vaccinated by Vaccine and Year, North Macedonia, 2010–2025

WUENIC vaccines administered at 2 months of age

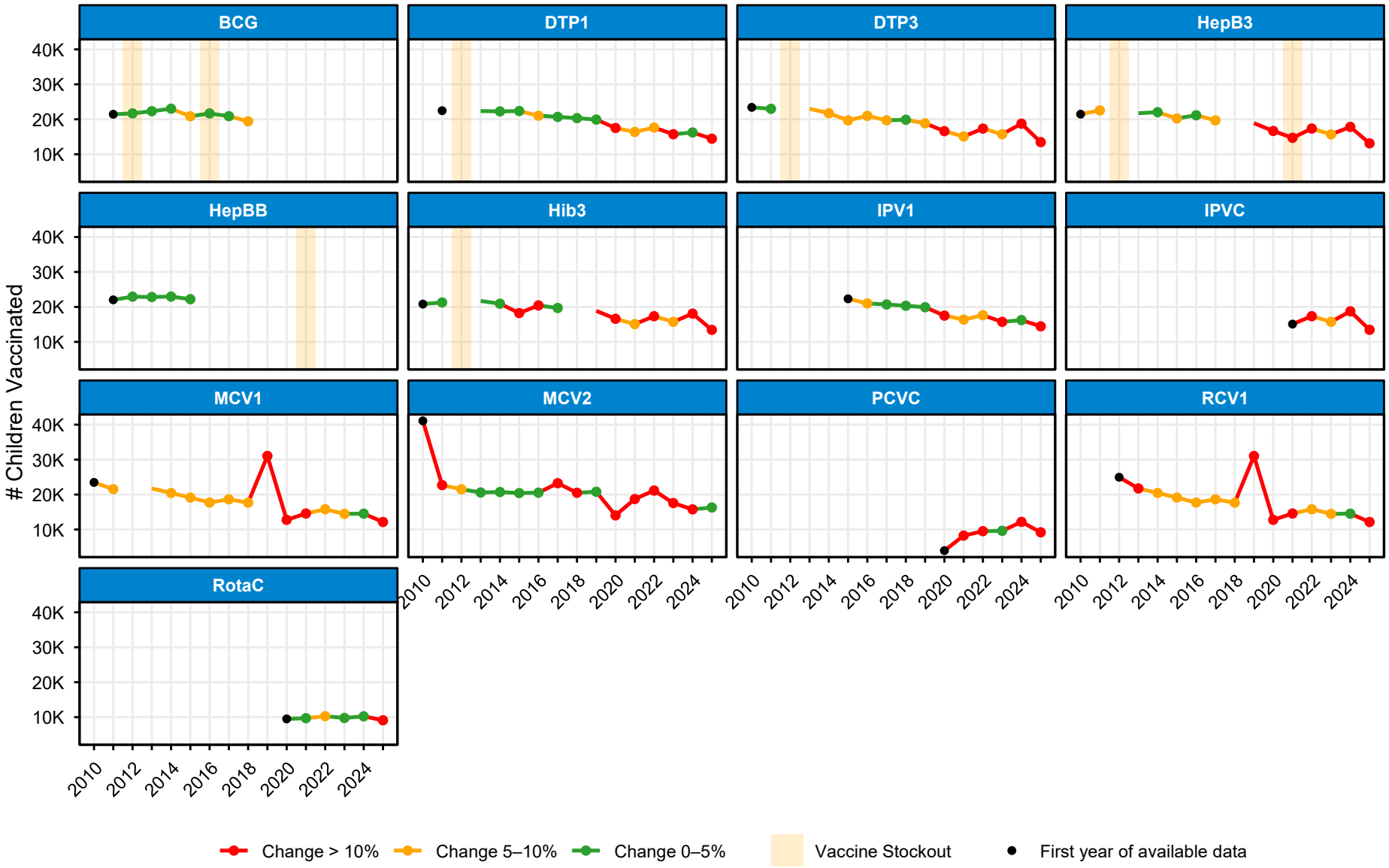


Number of children vaccinated with vaccines co-administered at the 2 months visit per the national schedule.

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Number of Children Vaccinated by Vaccine and Year, North Macedonia, 2010–2025



Gaps in line indicate missing admin data for that year.

Raw counts of children vaccinated (numerator) by vaccine and year. Points are colored by the percent change from previous year in the number of children vaccinated.

Green point = stable year-to-year count of children vaccinated.

Orange/red point = high fluctuation in number of children vaccinated, which may indicate data quality issues.

Black point = first year of available numerator data for that vaccine.

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WUENIC 2025 revision

Denominator Checks

Admin Data Comments: Denominator Source (2021–2024)

Year	Comment
2024	For birth doses the data in denominators are obtained by the birth services, maternity hospitals or patronage nurses. For the other data in denominators are obtained by the vaccinators from vaccination points.
2023	For birth doses the data in denominators are obtained by the birth services and maternity hospitals. For the other data in denominators are obtained by the vaccinators from vaccination points.
2022	The data in denominators are obtained by the birth services and maternity hospitals
2021	The data in the denominators are obtained by the birth services and maternity hospitals.

Explanation of how the denominators (target population) are obtained.

Admin Data Comments:
Denominator Accuracy (2021–2024)

Year	Comment
2024	Denominator bias in immunization coverage data can result from a different factors: inconsistent use of definitions of the target population, different data sources for target population, lack of data for population on displaced population out and in the country. These biases can lead to misleadingly high as well as low coverage estimates, underscoring the need for clearer definitions and improved population data systems. The denominator includes all eligible children: eligible birth cohort (or school cohort) according to the Regular Immunization Calendar as well as those eligible according to the Catch-up Calendar (older children who missed regular vaccination).
2023	Population movement in the country and abroad.
2022	Population movement in the country and abroad
2021	Population movement within the country and abroad

Factors limiting the accuracy of the denominator as reported by North Macedonia.

Number of Children in Target Population by Vaccine and Year, North Macedonia, 2010–2025



Gaps in line indicate missing admin data for that year.

Target population (denominator) by vaccine and year. Points are colored by the magnitude of year-on-year change: green for less than 5%, orange for 5–10%, and red for greater than 10%. Black points indicate there was no denominator data in the previous year (unable to calculate percent change). Light blue shading highlights years where the direction of change switches unexpectedly.

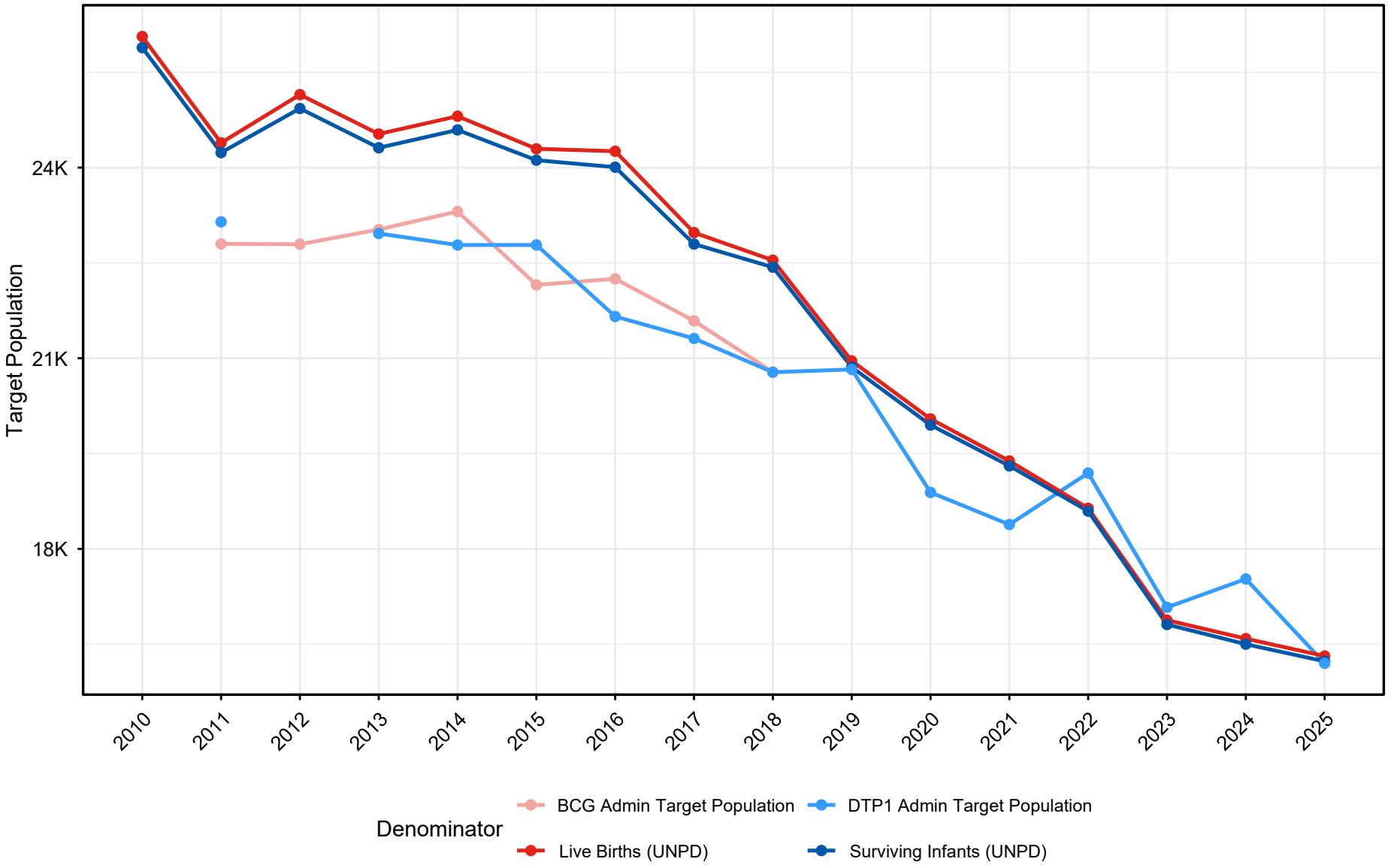
Target populations should follow a smooth, steady trajectory. Sudden directional switches are demographically unnatural and typically indicate administrative errors, shifting census boundaries, or changes in reporting sources.

Genuine switches are rare and generally limited to extreme disruptions such as humanitarian crises, cross-border migrations, or very small island populations.

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WUENIC 2025 revision

Live Births & Surviving Infants (UNPD) vs. Admin Denominators, North Macedonia, 2010–2025



Data from 2024 World Population Prospects (WPP) revision.

Comparison of trends in live births and surviving infants, 2010–2025.

Live births is used is the denominator for BCG and HepBB.

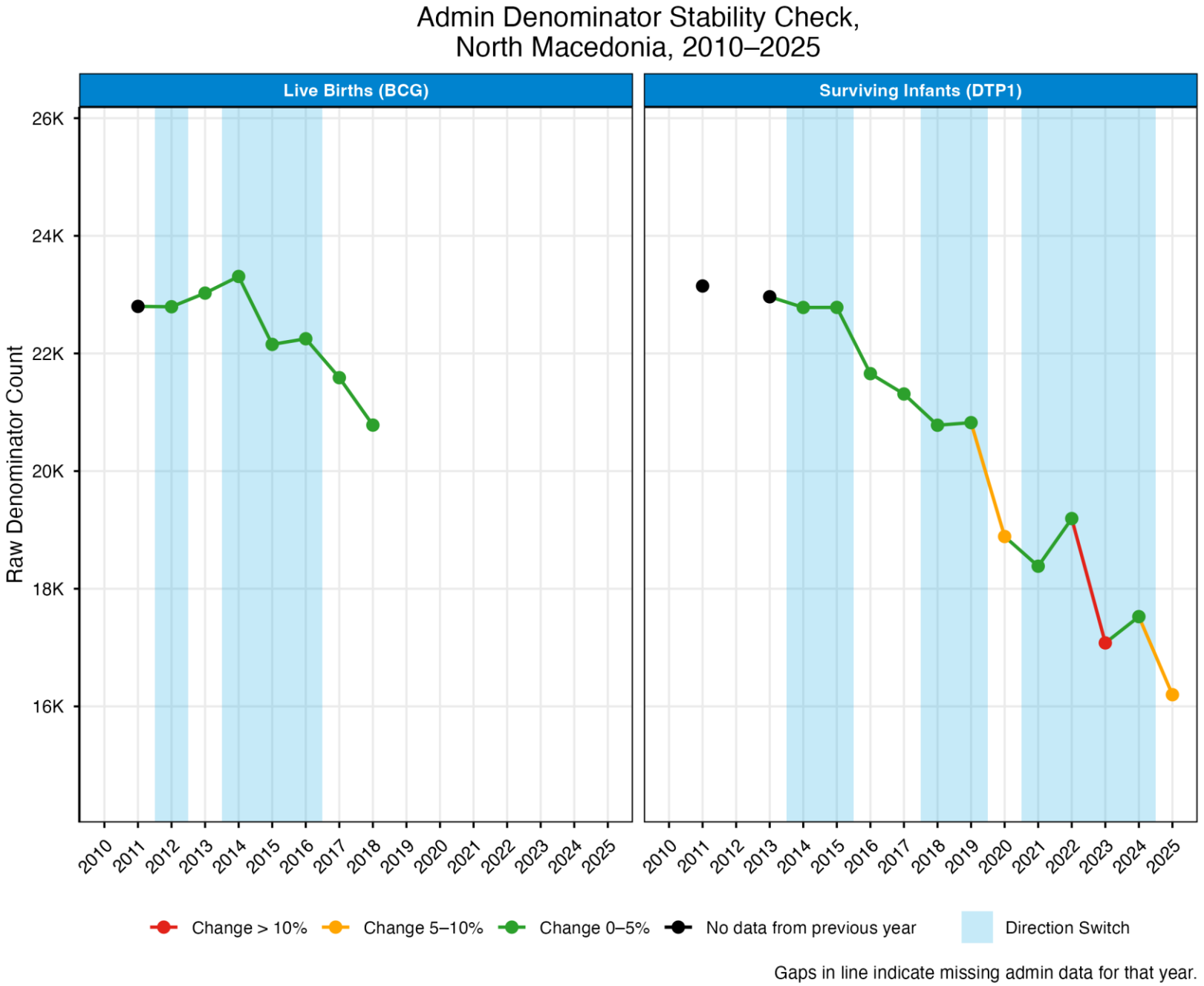
Surviving infants is used as the denominator for other vaccines given in the first year of life.

Admin target populations are reported by the country, while the United Nations Population Division (UNPD) produces the World Population Prospects (WPP) data.

UNPD is the United Nations Population Division.

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WUENIC 2025 revision



Number of children in the live births (BCG) and surviving infants (DTP1) administrative populations by year. Points are colored by the magnitude of year-on-year change: green for less than 5%, orange for 5–10%, and red for greater than 10%. Black points indicate there was no denominator data in the previous year (unable to calculate percent change). Light blue shading highlights years where the direction of change switches unexpectedly.

Under normal circumstances, target populations should follow a smooth, steady trajectory rather than fluctuating. Sudden switches in direction, such as an increasing population abruptly decreasing the following year, are demographically unnatural and typically indicate administrative errors, shifting census boundaries, or changes in reporting data sources without historic time series adjustment.

Genuine switches in growth direction are rare and generally limited to extreme disruptions like humanitarian refugee crises, cross-border migrations, or very small island populations.

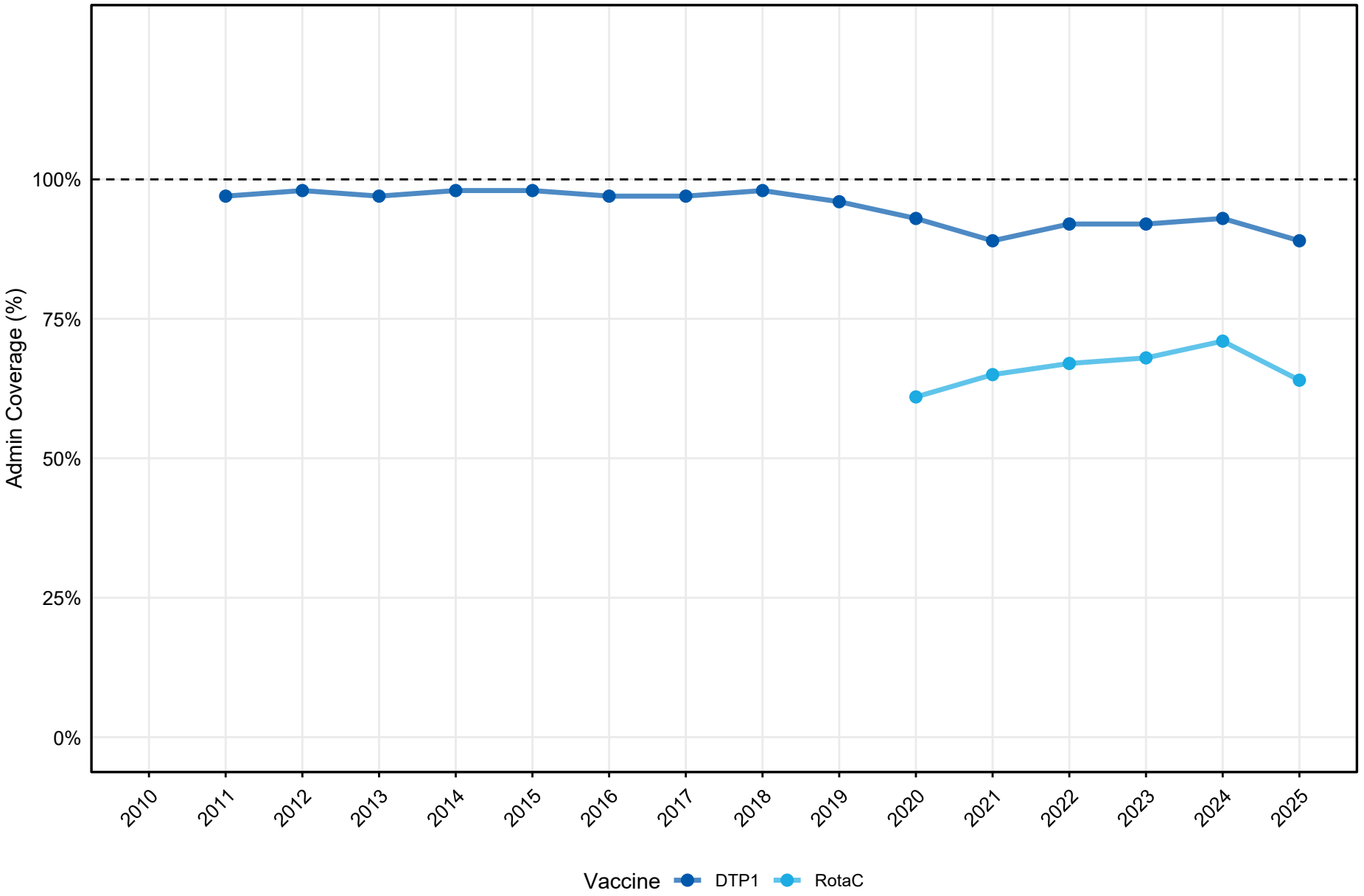
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WUENIC 2025 revision

Coverage of Vaccines Recommended at the Same Age

Admin Coverage of Vaccines Administered at 2 months, North Macedonia, 2010–2025



Admin coverage of WUENIC vaccines co-administered at the 2 months visit per the national schedule.

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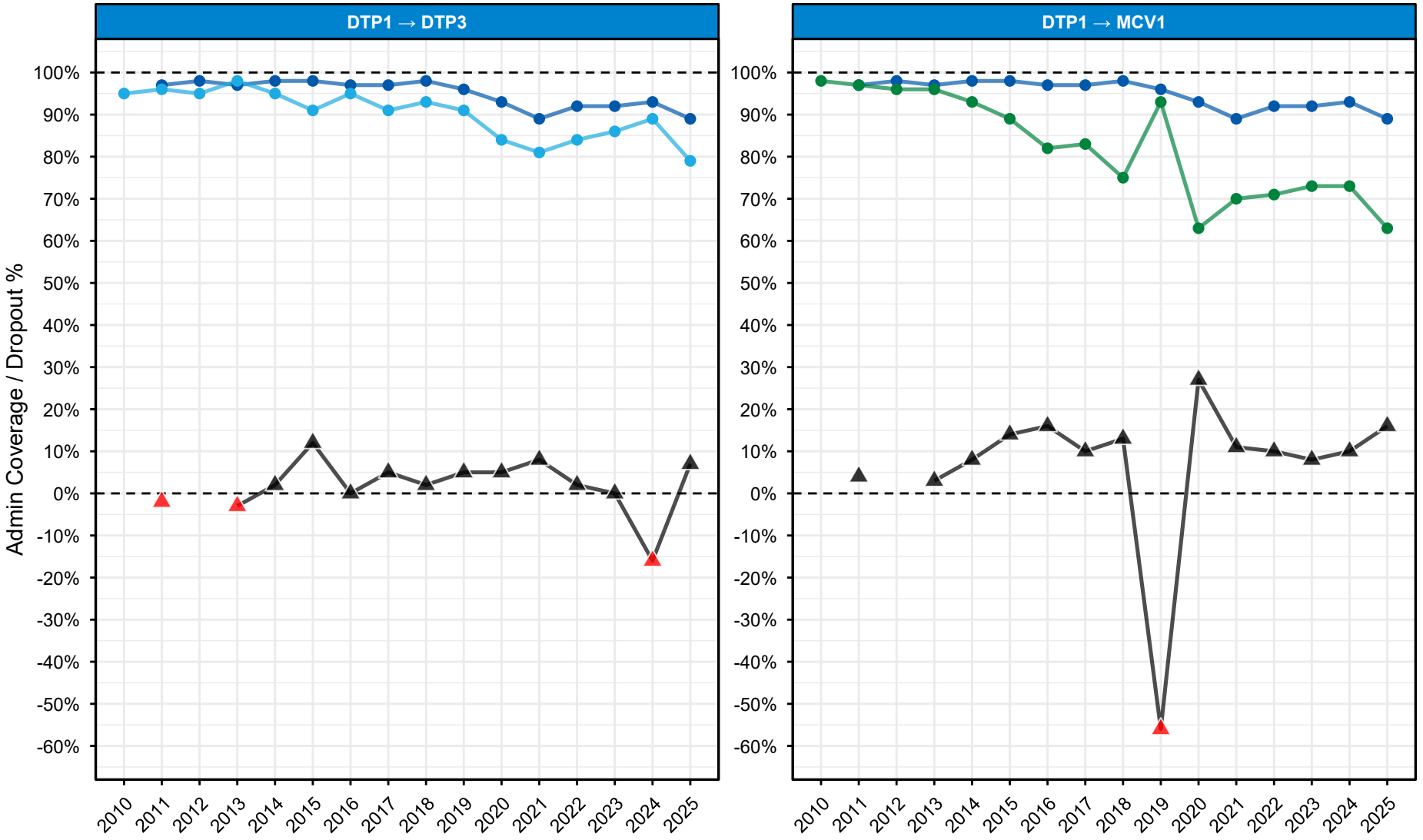
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WUENIC 2025 revision

Vaccine Dropout

Key Vaccine Dropout, North Macedonia, 2010–2025

Circles = Admin Coverage | Triangles = Dropout %



Dropout % = (Dose 1 - Dose 2) / Dose 1 * 100

Admin coverage for key vaccine pairs (DTP1→DTP3, DTP1→MCV1) with dropout rate shown as triangles. High dropout may indicate supply, access, or demand barriers.

A normal dropout rate means more children received DTP1 than DTP3 or MCV1, which is expected. A negative dropout rate means more children received DTP3/MCV1 than DTP1.

For DTP1–DTP3, negative dropout almost certainly reflects data quality issues, as a child cannot receive the third dose without first receiving the first dose.

While a child can receive MCV1 without DTP1, negative dropout is generally unusual as MCV1 is recommended later in infancy. Negative dropout may occur in instance of outbreak response, but campaigns often include older children, which may contaminate the numerator and lead to misinterpretation.

Coverage Comparison Between WUENIC, Admin, and Official Estimates

Coverage Trends by Vaccine and Source, North Macedonia, 2021–2025



WUENIC HPV coverage estimates not included.
White = not yet introduced or not reported. Grey = missing data.
Survey panel not presented as North Macedonia reported no survey data.

Coverage by vaccine and data source (WUENIC, Admin, Official, Survey) for the most recent 5 years.

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WUENIC 2025 revision

Coverage vs. WUENIC Estimates by Source, North Macedonia, 2021–2025

	WUENIC					Admin					Official (Government Estimate)				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
BCG	93	93	93	93	93	—	—	—	—	—	—	—	—	—	—
HepBB	97	97	97	97	97	—	—	—	—	—	—	—	—	—	—
DTP1	89	92	92	93	89	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
DTP3	81	84	86	89	79	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
Hib3	81	84	86	91	79	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
HepB3	79	84	86	91	77	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
PCVC	53	56	56	72	60	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
RotaC	65	67	68	71	64	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
IPV1	89	92	92	93	89	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
IPVC	81	84	86	89	79	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
MCV1	70	71	73	73	63	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
RCV1	70	71	73	73	63	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
MCV2	80	89	88	79	85	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0

WUENIC coverage: 60 70 80 90

Difference in pp vs. WUENIC: −10pp −5pp 0 +5pp +10pp

Missing Data

WUENIC panel shows absolute coverage. All other panels show percentage point difference vs. WUENIC estimate.

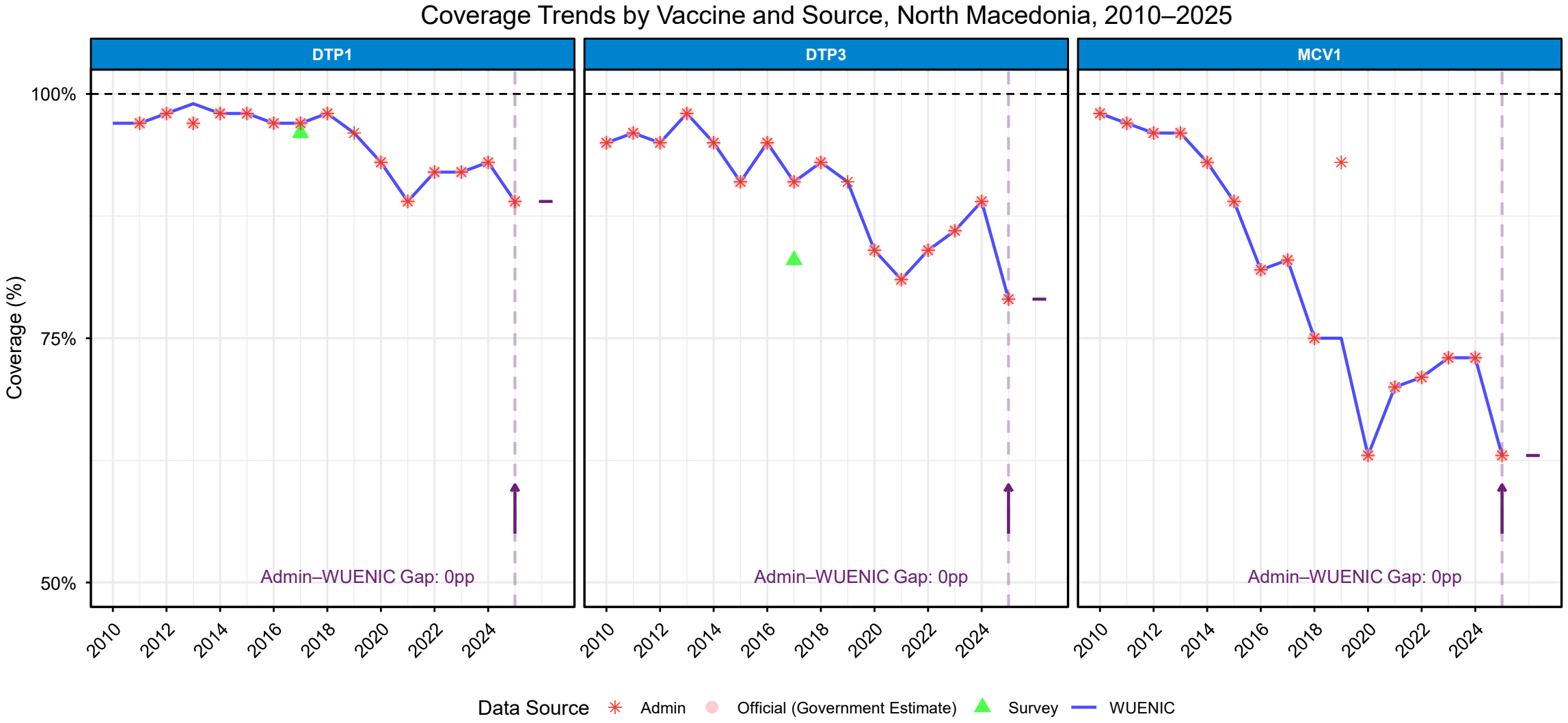
White = not yet introduced or not reported. Grey = missing data.
Survey panel not presented as North Macedonia reported no survey data.

Difference in percentage points between administrative, official, and survey coverage and WUENIC estimates (e.g., Admin - WUENIC) for the most recent 5 years.

A difference of zero indicates that the coverage source and WUENIC estimate are identical, usually indicating that source informed the WUENIC estimate.

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WUENIC 2025 revision



Coverage trends for DTP1, DTP3, and MCV1 by data source, 2010–2025.

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Actionable Health Analytics for Decision-making (AHEAD)

AHEAD is a UNICEF initiative that strengthens the quality and use of routine immunization data by working closely with Ministries of Health and national Expanded Programme on Immunization (EPI) teams.

AHEAD begins with a systematic review of routine immunization data to identify and address data quality issues, including missing or inconsistent reporting, internal inconsistencies, implausible year-to-year fluctuations, and inaccuracies in target population denominators. Through a collaborative process with national teams, reported data are reviewed, cleaned, and validated, while alternative denominator sources are assessed to improve the accuracy and interpretation of vaccination coverage estimates.

Building on these strengthened data, AHEAD produces timely subnational immunization analytics at regional, district, and health facility levels to identify priority areas, monitor trends, and support evidence-based planning and targeted interventions.

Please contact UNICEF for more information at: data@unicef.org

AHEAD





