EPIDEMIOLOGY OF RESPIRATORY PATHOGENS FROM INFLUENZA-LIKE ILLNESS AND PNEUMONIA SURVEILLANCE PROGRAMMES, SOUTH AFRICA, 2018

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Executive summary

Syndromic respiratory illness surveillance programmes coordinated by the National Institute for Communicable Diseases include pneumonia surveillance, influenza-like illness (ILI) (2 programmes-systematic ILI at public health clinics and the Viral Watch programme) and the respiratory morbidity surveillance system. South Africa's 2018 influenza season started in week 18 and was predominated initially by influenza A(H1N1)pdm09 with circulation of influenza B towards the end of the season (week 40). There were 20 sporadic cases of A(H3N2). The overall vaccine effectiveness (VE), adjusted for age and seasonality, was 57% (95% CI 19% to 77%) against influenza A(H1N1)pdm09 and 14% (95% CI -120 % to 67%) against influenza B. The respiratory syncytial virus (RSV) season preceded the influenza season, starting in week 7. There was no obvious seasonality identified for *Bordetella pertussis.* However, an increase in pertussis cases was noted among patients enrolled in pneumonia surveillance from July onwards. Among ILI cases, the commonest pathogen identified in individuals aged <15 years was influenza (17%; 73/428) and RSV (10%; 42/428) followed by *B. pertussis* (3%; 11/428). Among individuals aged ≥15 years influenza (10%) was also most commonly detected followed by RSV (3%; 7/292) and *B. pertussis* (2%; 5/292%). Among individuals enrolled as part of pneumonia surveillance aged <5 years, the most common pathogen was RSV (27%; 792/2901) followed by influenza (7%; 206/2901) and *B. pertussis* (3%; 81/2901). Among individuals aged ≥15 years, influenza (6%; 103/1729) was most common, followed by RSV (2%; 28/1729) and *B. pertussis* (1%; 17/1729). Overall in-hospital case fatality ratio among individuals enrolled as part of pneumonia surveillance was 3% (153/4627).

Introduction

The Centre for Respiratory Diseases and Meningitis (CRDM) of the National Institute for Communicable Diseases (NICD) coordinates the following syndromic respiratory illness programmes: pneumonia surveillance, influenza-like illness (ILI) (2 programmes: systematic ILI at public health clinics and the Viral Watch programme, private general practitioners) and the respiratory morbidity surveillance system. This report describes the findings from these programmes for the year 2018 for the following core respiratory pathogens: influenza virus, respiratory syncytial virus (RSV) and *Bordetella pertussis* (pertussis).

Methods

A brief summary of each surveillance programme is included below. Respiratory specimens from all sites were tested for three core pathogens: influenza virus, RSV and *B. pertussis*.

Description of the surveillance programmes

The primary objectives of the pneumonia and systematic ILI surveillance programmes are to describe the burden and aetiology of inpatient severe respiratory illness and outpatient ILI, respectively, in HIV-infected and HIV-uninfected individuals of all ages at selected sentinel sites in South Africa. In addition, specific objectives include describing the timing and severity of the influenza and RSV seasons, describing the epidemiology of *B. pertussis,* characterising circulating influenza virus strains to guide decisions around Southern Hemisphere influenza vaccine composition, annual estimates of influenza vaccine effectiveness and detecting outbreaks caused by the pathogens included as part of surveillance.

Pneumonia surveillance is an active, prospective, hospital-based surveillance programme for severe respiratory illness. Patients admitted at the surveillance sites meeting the standardized clinical case definition of severe respiratory illness (SRI) are prospectively enrolled (Table1). For the purpose of comparison SRI is further divided into severe acute respiratory illness (SARI), in those with symptom duration of ≤10 days, and severe chronic respiratory illness (SCRI) in those with symptom duration of >10 days. Dedicated staff screened and enrolled patients from Monday to Friday each week. Clinical and epidemiological data were collected using standardized questionnaires. Information on in-hospital management and outcome were collected. All completed forms were shipped to NICD for data entry. Samples collected and tested varied by site and case definition (Table 2). Combined

nasopharyngeal (NPS) and oropharyngeal swabs (OPS) were collected at all sites that conduct core surveillance. At the three enhanced sites, nasopharyngeal aspirates were collected instead of combined NPS and OPS from children aged <1 year. Sputum samples (induced or expectorated) were collected at enhanced sites (Table 2).

The systematic ILI surveillance programme was established in 2012. It is currently active at public health clinics serviced by Edendale Hospital (EDH) and Klerksdorp-Tshepong Hospital Complex (KTHC). Patients presenting at these sites meeting the ILI and suspected pertussis case definitions (Table 1) were enrolled prospectively. Dedicated staff screened and enrolled patients for systematic ILI surveillance from Monday to Friday. Clinical and epidemiological data were collected using standardized questionnaires and nasopharyngeal samples were collected for testing (Table 2).

The Viral Watch sentinel surveillance programme was started in 1984 to monitor influenza activity. The programme is mainly composed of general practitioners who voluntarily submit NPS or OPS from patients who meet the ILI definition (Table1). Data from this programme have been used since 2005 to estimate the effectiveness of trivalent seasonal influenza vaccine (TIV) against influenza-associated medically-attended acute respiratory illness using a test-negative case control study design.[1,2] For this report, patients with ILI presenting to the sentinel surveillance sites during the 2018 influenza season were used to calculate vaccine effectiveness (VE). During 2018, 89 practitioners registered across South Africa submitted specimens throughout the year.

The start of the RSV seasons is defined as at least two consecutive weekly detection rates of ≥10%. The season is considered to have ended when the detection rate of RSV drops below 10% for two consecutive weeks. The influenza season was declared by applying the Moving Epidemic Method (MEM) method by which thresholds are calculated through a sequential analysis using the R Language (available from: http://CRAN.R-project.org/web/package=mem). This method is designed to calculate the duration, start and end of an annual influenza epidemic. MEM uses the 40th, 90th and 97.5th percentiles established from available years of historical data to calculate thresholds of activity. Thresholds of activity for influenza are categorized as follows: Below seasonal threshold, low activity, moderate activity, high activity and very high activity. For influenza, thresholds from outpatient influenza like illness (Viral Watch Programme) are used as an indicator of disease

transmission in the community and thresholds from pneumonia surveillance are used as an indicator of impact of disease.

The respiratory morbidity surveillance system tracks trends in the number of pneumonia and influenza hospitalizations using anonymised data from a private hospital group.

Table 1: Case definitions by age group and surveillance site/programme for the clinical syndromes included in the influenza-like illness (ILI) and pneumonia surveillance programmes, South Africa, 2018.

Case definition	Criteria	Surveillance site/programme
Influenza-like illness (ILI)	**Patients of all ages** Acute fever of ≥38°C and/or self-reported fever within the last 10 days AND cough	Viral Watch programme and public health clinics for systematic ILI surveillance: Jouberton and Edendale Gateway
Severe respiratory illness (SRI)	**2 days - <3 months** Any child hospitalised with diagnosis of suspected sepsis or physician diagnosed LRTI irrespective of signs and symptoms.	EDH, KTHC, Matikwana/Mapulaneng, RMMCH/HJH, RCH/MPH Pneumonia surveillance
	3 months - <5 years Any child ≥3 months to <5 years hospitalised with physician-diagnosed LRTI including bronchiolitis, pneumonia, bronchitis and pleural effusion	EDH, KTHC, Matikwana/Mapulaneng, RMMCH/HJH, RCH/MPH Pneumonia surveillance
	≥5 years Any person hospitalised with a respiratory infection with fever (≥38ºC) or history of fever AND cough	EDH, KTHC, Matikwana/Mapulaneng, RMMCH/HJH, RCH/MPH Pneumonia surveillance
Suspected pertussis	Any patient presenting with cough illness of any duration and at least one of the following: paroxysms of cough, post-tussive vomiting, inspiratory whoop **OR** Infants <1 year with apnoea, with or without cyanosis.	Public health clinics for systematic ILI surveillance: Jouberton and Edendale Gateway EDH, KTHC, Matikwana/Mapulaneng, RMMCH/HJH, RCH/MPH Pneumonia surveillance

EDH=Edendale Hospital (KwaZulu-Natal), KTHC=Klerksdorp-Tshepong Hospital Complex (North-West Province), RMMCH/HJH= Rahima Moosa Mother and Child Hospital/Helen Joseph Hospital (Gauteng), RCH/MPH=Red Cross War Memorial Children's Hospital/ Mitchell's Plain Hospital (Western Cape), LRTI= Lower respiratory tract infection

Table 2: Pathogens tested for by clinical syndrome/programme, surveillance site, type of specimen collected and tests conducted, influenza-like illness (ILI) and pneumonia surveillance programmes, South Africa, 2018.

Pathogen	Programme (syndrome)	Surveillance site	Specimens collected	Tests conducted
Influenza and RSV	Viral Watch (ILI)	All Viral Watch sites in 8 provinces	Nasopharyngeal (NP) and oropharyngeal (OP) flocked swabs in universal transport medium (UTM)	Multiplex real-time reverse transcription polymerase chain reaction (PCR)
	Systematic ILI	Edendale Gateway Clinic, Jouberton Clinic	NP and OP flocked swabs from individuals aged ≥1years and NPA from children aged <1years in UTM	
	Pneumonia surveillance (SRI)	RMMCH/HJH, RCH/MPH	NP and OP flocked swabs (all age groups) in UTM	
		EDH, KTHC and Matikwana/ Mapulaneng	NP and OP flocked swabs from individuals aged ≥1years and NPA from children aged <1years in UTM	
Bordetella pertussis	Systematic ILI	Edendale Gateway Clinic and Jouberton Clinic	NP and OP flocked swabs in UTM	Multiplex real time PCR
			NP in Regan Lowe medium	Culture
	Pneumonia surveillance (SRI)	RMMCH/HJH, RCH/MPH	NP and OP flocked swabs in UTM	Multiplex real time PCR
			NP in Regan Lowe medium	Culture
		EDH, KTHC and Matikwana/ Mapulaneng	NP and OP flocked swabs from individuals aged ≥1years and NPA from children aged <1years in UTM	Multiplex real time PCR
			Sputum (induced/expectorated)	Culture
			NPS in Regan Lowe medium	

ILI= influenza-like illness, SRI=severe respiratory illness, EDH= Edendale Hospital, KTHC=Klerksdorp-Tshepong Hospital Complex, RMMCH/HJH= Rahima Moosa Mother and Child Hospital/Helen Joseph Hospital, RCH/MPH=Red Cross War Memorial Children's Hospital/Mitchell's Plain. NPA= nasopharyngeal aspirate, NPS=nasopharyngeal swab

Sample collection and laboratory testing for pneumonia and ILI surveillance

Upper respiratory tract samples (NP/OP and NPA) were collected and placed into universal transport medium. Upper respiratory samples and blood were stored at 4°C at the local site laboratory, and were transported to NICD on ice within 72 hours of collection. Sputum samples were stored separately at -20˚C at the local site laboratory before being transported to NICD on dry ice on a weekly basis.

Detection of RSV and influenza

A commercial multiplex real-time reverse transcriptase PCR assay (Fast-Track Diagnostics, Luxembourg) was used for detection of influenza A virus, influenza B virus and RSV. Influenza A and B positive specimens were subtyped using US Centers for Diseases Control and Prevention (CDC) real-time RT PCR protocol and reagents (https://www.influenzareagentresource.org/).

Detection of Bordetella pertussis

Induced/expectorated sputum and nasopharyngeal samples were tested for *B. pertussis.* A specimen was considered positive for pertussis if it tested positive (on at least 2 out of 3 repeats) for *IS481* and/or *ptxS*1 genes with a Ct<45. A positive case of *B. pertussis* is defined as having either or both specimens testing positive by real-time PCR.

Data management and analysis

Data management is centralised at the NICD where laboratory, clinical and demographic data from enrolled patients are recorded on a Microsoft Access database with double data entry. Data included in this report are preliminary and may change as data cleaning is finalised.

Results

Pneumonia and systematic ILI surveillance

In 2018, 5386 patients were enrolled into the systematic ILI and pneumonia surveillance programmes. Nasopharyngeal (NP) and oropharyngeal (OP) swabs were collected from 5350 (99%) participants. Of these 13% (720) were enrolled in the ILI programme and 87% (4930) were hospitalized individuals (Figure 1). Those aged <15 years made up the majority of both ILI and SRI cases (60% 428/720 and 63% 2901/4930 respectively). The majority of individuals hospitalized with SRI aged <15 years had acute illness (94%; 2715/2901), while among individuals aged ≥15 years 50% (861/1729) had acute illness. The HIV prevalence varied by age group and case definition (Figure 2). HIV prevalence was highest in cases with SCRI (55%; 553/986) and similar in ILI and SARI (17%;

117/704 and 16%; 542/3353) cases respectively. HIV prevalence was highest in the 25-44 year age group for SARI and SCRI cases (76%; 285/375 and 83%;345/414 respectively) but highest in the 45-64 year age group (54%;43/79) year age group for ILI.

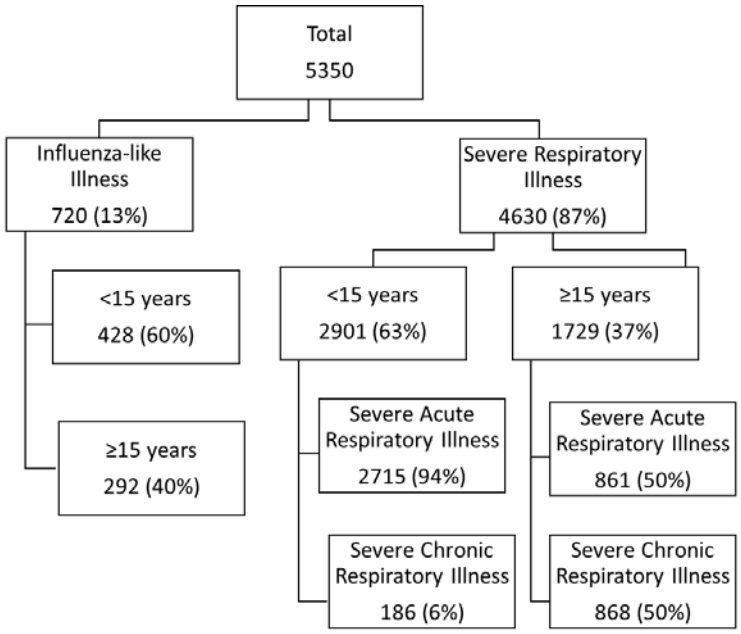

Figure 1: Individuals who had a nasopharyngeal (NP) sample collected by case definition in the systematic influenza-like illness (ILI) and pneumonia surveillance programmes (SRI), South Africa, 2018.

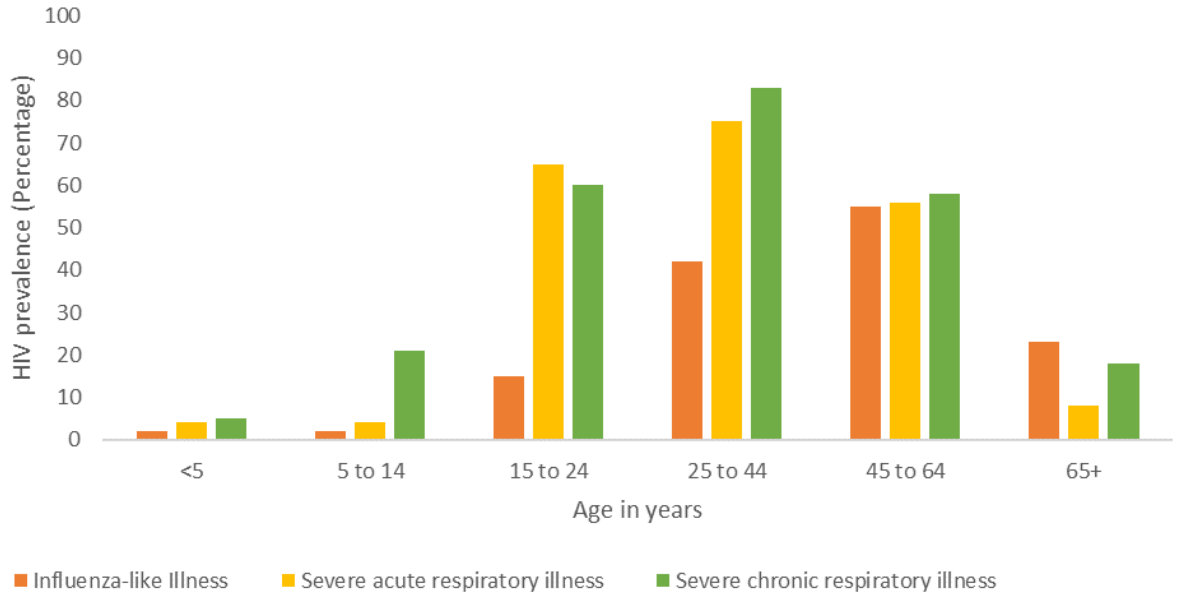

Figure 2: HIV prevalence by age group for individuals meeting case definitions of influenza-like illness (ILI=111/679, 16%), severe acute respiratory illness (SARI=534/3280, 16%) and severe chronic respiratory illness (SCRI=551/1004, 54%), among patients enrolled in pneumonia surveillance and influenza-like illness surveillance, 2018.

Influenza, RSV and pertussis in individuals aged <15 years enrolled into the systematic ILI programme

Nearly a third of the 428 individuals enrolled into the ILI systematic surveillance were aged 2-4 years (28%; 118/428). A similar proportion of those who tested positive for influenza were in the 2-4 year age group (44%; 32/73). This was different for those who tested positive for RSV, where 29% (12/42) were in the 6-11 month age group. Of the 11 pertussis cases 36% (4/11) were in very young infants aged 0-2 months. Vaccine coverage (vaccine up to date for age) was high with 90% of enrolled individuals having pneumococcal conjugate vaccine (PCV) up to date and 91% having *Haemophilus influenza* type B (HIB) vaccine up to date. Vaccine coverage was lower for those who tested positive for pertussis with 62% and 75% coverage for PCV and HIB respectively (Table 3a). A similar proportion of cases was enrolled across the sites, with the highest proportion of pertussis cases presenting at the Klerksdorp site (82%; 9/11).

Influenza, RSV and pertussis in individuals aged ≥15 years enrolled into the systematic ILI programme

Of individuals aged ≥15 years who met the case definition for ILI, 48% (140/292) were in the age group 25-44 years. The highest proportion of influenza and RSV cases were in the same age group, 25-44 years (influenza 50%; 14/28, RSV 63%; 5/8). Of the pertussis cases 2/5 (40%) were in the age groups 15-24 and 24-44 years respectively. Four of five pertussis cases were from Klerksdorp (Table 3b).

Table 3a: Demographic and clinical characteristics of patients aged <5 years enrolled into the systematic influenza-like illness surveillance programmes, South Africa, 2018.

	Overall n/N (%)	Influenza positive n/N (%)	RSV positive n/N (%)	*Bordetella pertussis* positive n/N (%)
Age group				
0 – 2 months	36/428 (8)	1/73 (1)	7/42 (17)	4/11 (36)
3 – 5 months	40/428 (9)	2/73 (3)	5/42 (12)	1/11 (9)
6 – 11 months	69/428 (16)	6/73 (8)	12/42 (29)	1/11 (9)
12 –23 months	61/428 (14)	8/73 (11)	2/42 (5)	0/11 (0)
2-4 years	118/428 (28)	32/73 (44)	11/42 (26)	2/11 (18)
5–14 years	105/428 (25)	24/73 (33)	5/42 (12)	3/11 (27)
Sex (Female)	216/428 (50)	34/73 (47)	21/42 (50)	6/11 (55)
Race (Black)	428/428 (100)	73/73 (100)	42/42 (100)	11/11 (100)
Site				
Edendale Gateway Clinic	202/428 (47)	39/73 (53)	20/42 (48)	2/11 (18)
Jouberton Clinic	229/428 (53)	34/73 (47)	22/42 (52)	9 (82)
HIV exposure (< 1 year)				
HIV-unexposed uninfected	89/140 (64)	3/8 (37)	12/24 (50)	3/6 (50)
HIV-exposed uninfected	48/140 (32)	5/8 (63)	12/24 (50)	3/6(50)
HIV infected	3/140 (2)	0	0	0
HIV-infected	6/424 (1)	1/72 (1)	0	0
Weight for age <–2 z scores	24/327 (7)	4/49 (8)	2/37 (5)	1/8 (13)
Premature	15/326 (5)	1/49 (2)	1/37 (3)	0/8 (0)
Other underlying illness[1]	1 (<1)	0	0	0
Up to date vaccination for age for PCV	275/306 (90)	41/46 (89)	31/35 (89)	5/8 (63)
Up to date vaccination for age for HIB	283/310 (91)	45/46 (98)	32/36 (89)	6/8 (75)

PCV= Pneumococcal conjugate vaccine HIB=*Haemophilus influenza* B

[1]Underlying conditions included any of the following: Asthma, other chronic lung disease, chronic heart disease (valvular heart disease, coronary artery disease, or heart failure excluding hypertension), seizures, liver disease (cirrhosis or liver failure), renal disease (nephrotic syndrome, chronic renal failure), immunocompromising conditions excluding HIV infection (organ transplant, immunosuppressive therapy, immunoglobulin deficiency, malignancy), neurological disease (cerebrovascular accident, spinal cord injury, seizures, neuromuscular conditions).

Table 3b: Demographic and clinical characteristics of patients aged ≥15 years enrolled into the systematic influenza like illness surveillance programme, South Africa, 2018.

	Overall n/N (%)	Influenza positive n/N (%)	RSV positive n/N (%)	*Bordetella pertussis* n/N (%)
Age group (years)				
15-24	60/292 (21)	10/28 (36)	1/8 (13)	2/5 (40)
25-44	139/292 (48)	14/28 (50)	5/8 (62)	2/5 (40)
45-64	79/292 (27)	3/28 (11)	2/8 (25)	1/5 (20)
≥65+	14/292 (5)	1/28 (4)	0	0
Sex (Female)	175/292 (60)	14/28 (50)	4/8 (50)	2/5 (40)
Race (Black)	292/292 (100)	28/28 (100)	8/8 (100)	5/5 (100)
Site				
Edendale Gateway Clinic	141/292 (48)	15/28 (54)	7/8 (88)	1/5 (20)
Jouberton Clinic	151/292 (52)	13/28 (46)	1/8 (13)	4/5 (80)
HIV-infected	111/279 (40)	13/27 (48)	4/8 (50)	3/5 (60)
Other underlying illness[1]	22/292 (8)	2/28 (7)	0/8 (0)	1/5 (20)

[1]Underlying conditions included any of the following: Asthma, other chronic lung disease, chronic heart disease (valvular heart disease, coronary artery disease, or heart failure excluding hypertension), seizures, liver disease (cirrhosis or liver failure), renal disease (nephrotic syndrome, chronic renal failure), immunocompromising conditions excluding HIV infection (organ transplant, immunosuppressive therapy, immunoglobulin deficiency, malignancy), neurological disease (cerebrovascular accident, spinal cord injury, seizures, neuromuscular conditions) or pregnancy.

Influenza, RSV and pertussis in individuals aged <15 years enrolled into the pneumonia surveillance programme

Of the 2901 individuals aged <15 years enrolled into the surveillance programme, 35% (1006/2901) were less than 3 months of age and 60% (1722/2901) were enrolled at the RCH/MPH sites. The majority presented with a symptom duration of less than 10 days (93%; 2696/2901) and spent less than 5 days in hospital (77%; 211/2901). The highest proportion of cases of RSV (42%; 333/792) and pertussis (68%; 55/81) were in very young infants (<3 months). The highest proportion of influenza cases were in the older infants (6-11 months 29%; 60/206). More than half of the pertussis cases were enrolled at the RCH/MPH sites (Table 4a). Overall 90% (275/306) of children were up to date for age for PCV and 91% (283/310) were up to date for age for HIB vaccine. However, vaccine

coverage in pertussis cases was lower, with only 75% (6/8) and 63% (5/8) of pertussis cases being up to date for age for PCV and HIB respectively.

Influenza, RSV and pertussis in individuals aged ≥15 years enrolled into the pneumonia surveillance programme

Of the 1729 individuals aged ≥ 15 years meeting the SRI case definition, the highest proportion were in the age group 25-44 years (49%;847/1729). Of these individuals, half had symptoms for ≤10 days (50%; 864/1729) and two thirds were HIV infected (65%; 1022/1606). The length of hospital stay was greater than in younger individuals (<15 years), with 64% (1078/1697) spending ≥5 days in hospital. In-hospital mortality was also higher than in the <15 year age group, with 7% (128/1729) dying in hospital. The HIV prevalence was highest in individuals who tested positive for pertussis (82%; 14/17) as compared to influenza (60%; 59/99) and RSV (71%; 20/28). Nearly half the pertussis cases were enrolled at the Klerksdorp site (47% 8/17) (Table 4b).

Table 4a: Demographic and clinical characteristics of patients aged <15 years enrolled into the pneumonia surveillance programme, South Africa, 2018.

	Overall n/N(%)	Influenza positive n/N(%)	RSV positive n/N(%)	*Bordetella pertussis* positive n/N(%)
Age group months				
0 – 2 months	1006/2901 (35)	17/206 (8)	333/792 (42)	55/81 (68)
3 – 5 months	443/2901 (15)	19/206 (9)	182/792 (23)	5/81 (6)
6 – 11 months	540/2901 (19)	60/206 (29)	152/792 (19)	9/81 (11)
12 –23 months	434/2901 (15)	47/206 (23)	82/792 (10)	2/81 (2)
2-4 years	362/2901 (12)	50/206 (24)	38/792 (5)	7/81 (9)
5 –14 years	116/2901 (4)	13/206 (6)	5/792 (1)	3/81 (4)
Sex (female)	1233/2901 (42)	88/206 (43)	336/792 (42)	48/81 (59)
Race (Black)	2050/2901 (71)	151/2901 (73)	551/792 (70)	55/81 (68)
Site				
Mapulaneng/Matikwana	164/2901 (6)	23/206 (11)	46/792 (6)	5/81 (6)
Edendale Hospital	326/2901 (11)	19/206 (1)	76/792 (10)	4/81 (5)
KTHC	211/2901 (7)	17/206 (8)	34/792 (4)	12/81 (15)
RMMCH/HJH	480/2901 (16)	34/206 (16)	156/792 (20)	12/81 (21)
RCH/MPH	1720/2901 (60)	113/206 (55)	480/792 (61)	43/81 (53)
Symptoms ≤10 days	2696/2901 (93)	21/206 (10)	28/792 (95)	68/81 (84)
HIV exposure (<1 year)				
HIV-unexposed uninfected	1412/1871 (75)	59/91 (65)	521/649 (50)	50/64 (78)
HIV-exposed uninfected	425/1871 (23)	31/91 (34)	126/649 (19)	14/64 (23)
HIV- infected	34/1871 (2)	1/91 (1)	2/649 (<1)	0/64 (0)
Weight for age <–2 z scores[1]	493/2794 (18)	32/192 (17)	98/786 (12)	13/78 (17)
Premature	539/2795 (19)	32/193 (17)	155/787 (20)	14/78 (18)
Other underlying illness[1]	40/2901 (1)	7/206 (3)	3/792 (<1)	1/81 (1)
Up to date vaccination for age for PCV	1940/2170 (89)	172/185 (93)	571/622 (92)	34/50 (68)
Up to date vaccination for age for HIB	1983/2671 (74)	177/188 (94)	577/766 (75)	36/72 (50)
Duration of hospitalization <5 days	2211/2875 (77)	165/201 (82)	597/790 (76)	54/80 (68)
ICU admission	72/2901 (2)	4/206 (2)	25/792 (3)	4/81 (5)
In-hospital mortality	25/2901 (1)	2/206 (1)	2/792 (<1)	2/81 (2)

RMMCH/HJH=Rahima Moosa Mother and Child Hospital/Helen Joseph Hospital, KTHC=Klerksdorp Tshepong Hospital Complex, EDH=Edendale Hospital, RCH/MPH =Red Cross Hospital/Mitchell's Plain Hospital PCV= Pneumococcal conjugate vaccine HIB=*Haemophilus influenza* B

[1]Underlying conditions included any of the following: Asthma, other chronic lung disease, chronic heart disease (valvular heart disease, coronary artery disease, or heart failure excluding hypertension), liver disease (cirrhosis or liver failure), renal disease (nephrotic syndrome, chronic renal failure), prematurity, malnutrition, seizures, immunocompromising conditions excluding HIV infection (organ transplant, immunosuppressive therapy, immunoglobulin deficiency, malignancy), neurological disease (cerebrovascular accident, spinal cord injury, seizures, neuromuscular conditions)

Table 4b: Demographic and clinical characteristics of patients aged ≥15 years enrolled into the pneumonia surveillance programme, South Africa, 2018.

	Overall n/N (%)	Influenza positive n/N (%)	RSV positive n/N (%)	*Bordetella pertussis* positive n/N (%)
Age group years				
15-24	134/1729 (8)	9/103 (9)	5/28 (18)	3/17 (18)
25-44	844/1729 (49)	45/103 (44)	10/28 (35)	10/17 (59)
45-64	545/1729 (32)	36/103 (35)	11/28 (39)	4/17 (24)
≥65	206/1729 (12)	13/103 (13)	2/28 (7)	0/17 (0)
Sex (female)	880/1729 (51)	60/103 (58)	17/28 (61)	13/17 (76)
Race (Black)	1531/1729 (89)	89/103 (86)	22/28 (79)	15/17 (88)
Site				
Mapulaneng/Matikwana	145/1729 (8)	19/103 (19)	0/28 (0)	0/17 (0)
Edendale Hospital	372/1729 (22)	19/103 (19)	6/28 (22)	4/17 (24)
KTHC	480/1729 (28)	21/103 (20)	9/28 (32)	8/17 (47)
HJH	542/1729 (32)	35/103 (34)	6/28 (21)	2/17 (12)
MPH	190/1729 (11)	9/103 (9)	7/28 (25)	3/17 (18)
Symptoms ≤10 days	864/1729 (50)	66/103 (64)	18/28 (64)	8/17 (47)
HIV-infected	1022/1606 (65)	59/99 (60)	20/28 (71)	14/17 (82)
Other underlying illness[1]	338/1732 (20)	30/103 (29)	5/28 (18)	5/17 (29)
Duration of hospitalization <5 days	619/1697 (36)	52/102 (51)	10/28 (36)	9/17 (53)
ICU admission	10/1726 (1)	2/102 (2)	0/28 (0)	0/17 (0)
In-hospital mortality	128/1729 (7)	6/103 (6)	5/28 (18)	1/17 (6)

HJH=/Helen Joseph Hospital, KTHC=Klerksdorp Tshepong Hospital Complex, EDH=Edendale Hospital, MPH = Mitchell's Plain Hospital.

[1]Underlying conditions included any of the following: Asthma, other chronic lung disease, chronic heart disease (valvular heart disease, coronary artery disease, or heart failure excluding hypertension), liver disease (cirrhosis or liver failure), renal disease (nephrotic syndrome, chronic renal failure), prematurity, malnutrition, seizures, immunocompromising conditions excluding HIV infection (organ transplant, immunosuppressive therapy, immunoglobulin deficiency, malignancy), neurological disease (cerebrovascular accident, spinal cord injury, seizures, neuromuscular conditions).

The 2018 influenza season

Viral Watch Programme

The influenza season started in week 18 (first week of May) when the detection rate for influenza in the Viral Watch Programme rose above the seasonal threshold. The season ended in week 41 (second week of October). The Viral Watch Programme received 1459 specimens, from which influenza was detected in 689 of them - 388 (56%) influenza A(H1N1)pdm09, 278 (40%) influenza B and 20 (3%) influenza A (H3N2). Three influenza A samples were not subtyped due to a low viral load in the specimen (Figure 3).

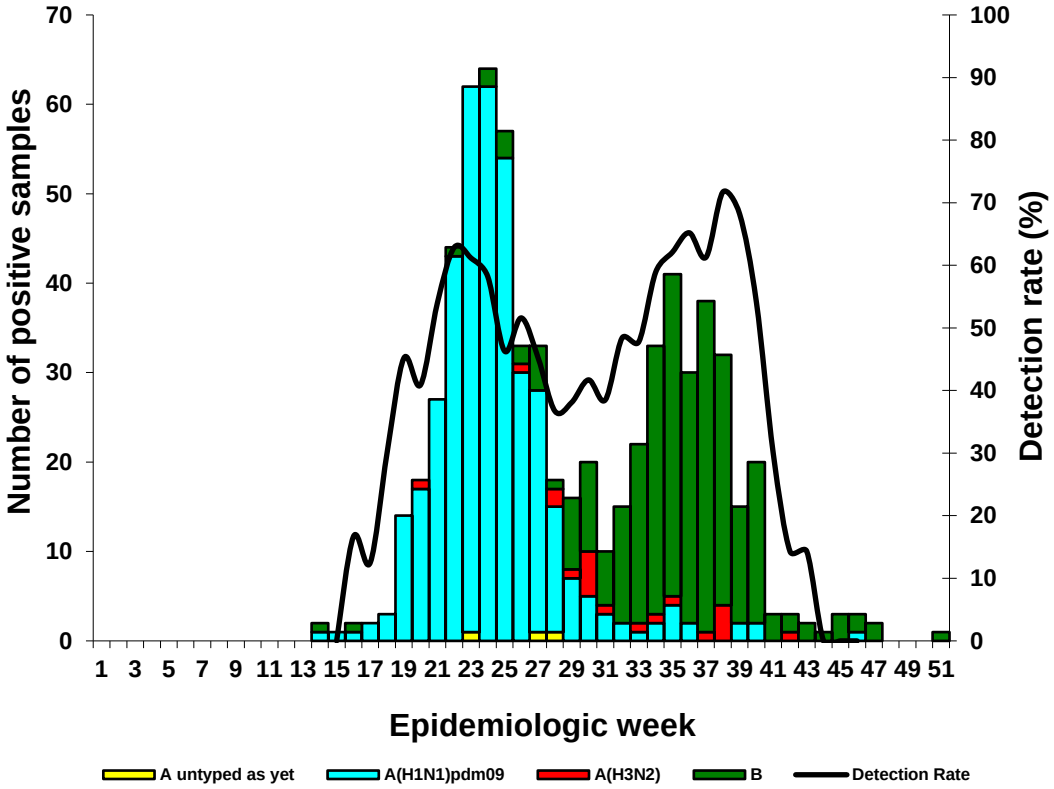

Figure 3: Numbers of samples and influenza detection rate by viral type, subtype and week for patients meeting the case definition of influenza-like illness (ILI), Viral Watch programme, South Africa, 2018.

The transmissibility of influenza was estimated by applying the MEM method to plot the 2018 Viral Watch detection rate against thresholds set by data collected from Viral Watch between 2009 and 2017 (Figure 4). For the 2018 influenza season, the transmissibility of influenza was mostly moderate. In the week of the highest detection rate for influenza B, the transmissibility crossed to the high range.

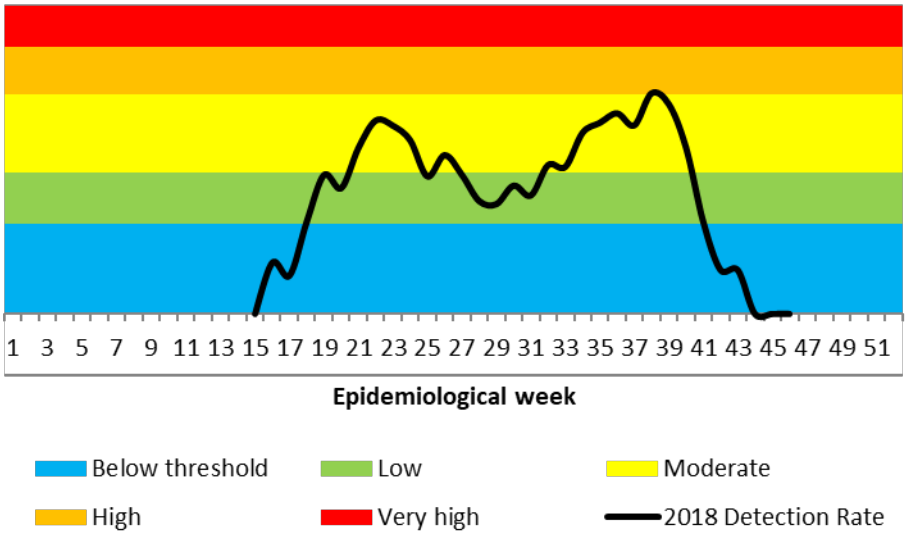

Figure 4: Viral Watch 2018 influenza transmissibility thresholds based on 2007-2017 data (excluding the pandemic year: 2009), South Africa, 2018.

Influenza season systematic ILI programme

In the systemic ILI programme, of the 720 specimens tested, 14% (101) were positive for influenza. Influenza A (H1N1)pdm09 accounted for 66% (n=67) of the samples and these were collected between week 15 and week 31. The remaining 33% (33) of specimens tested positive for influenza B and were collected between week 34 and week 40 (Figure 5).

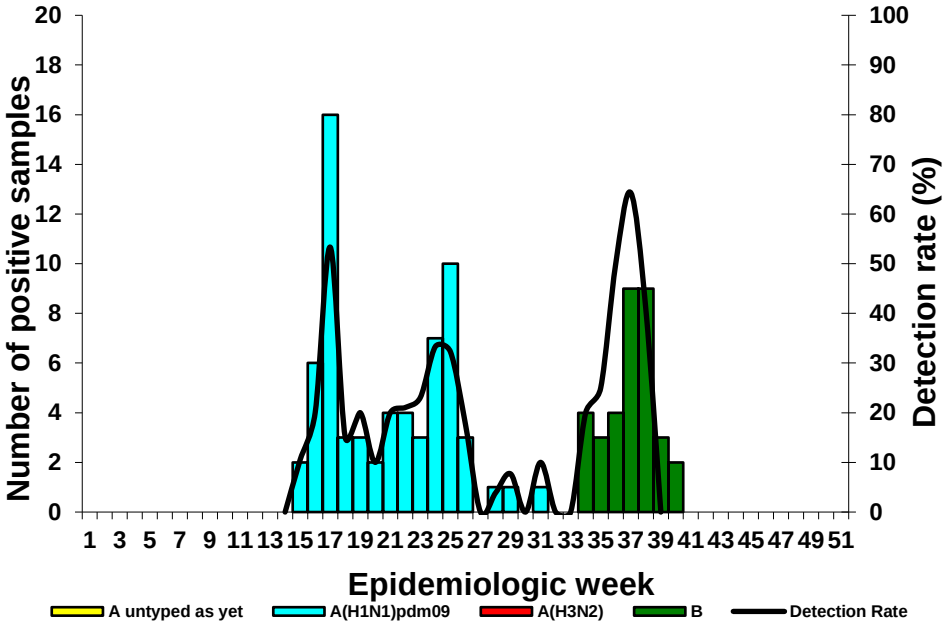

Figure 5: Influenza detection rate, by influenza type, subtype and week, in patients enrolled with influenza-like Illness (ILI) at the two primary healthcare clinics, South Africa, 2018.

The national syndromic pneumonia surveillance programme

In the pneumonia surveillance programme 309/4630 (7%) influenza cases were detected, most of which were influenza A (H1N1)pdm09 173/309 (56%). Influenza B accounted for 133/309 (43%) cases. A single influenza A (H3N2) was detected. Two influenza A were not subtyped due to low viral load. In the Viral Watch Programme the first part of the season was predominately influenza A(H1N1)pdm09 and the second part was predominately influenza B (Figure 6). The impact of the 2018 influenza season was moderate (Figure 7).

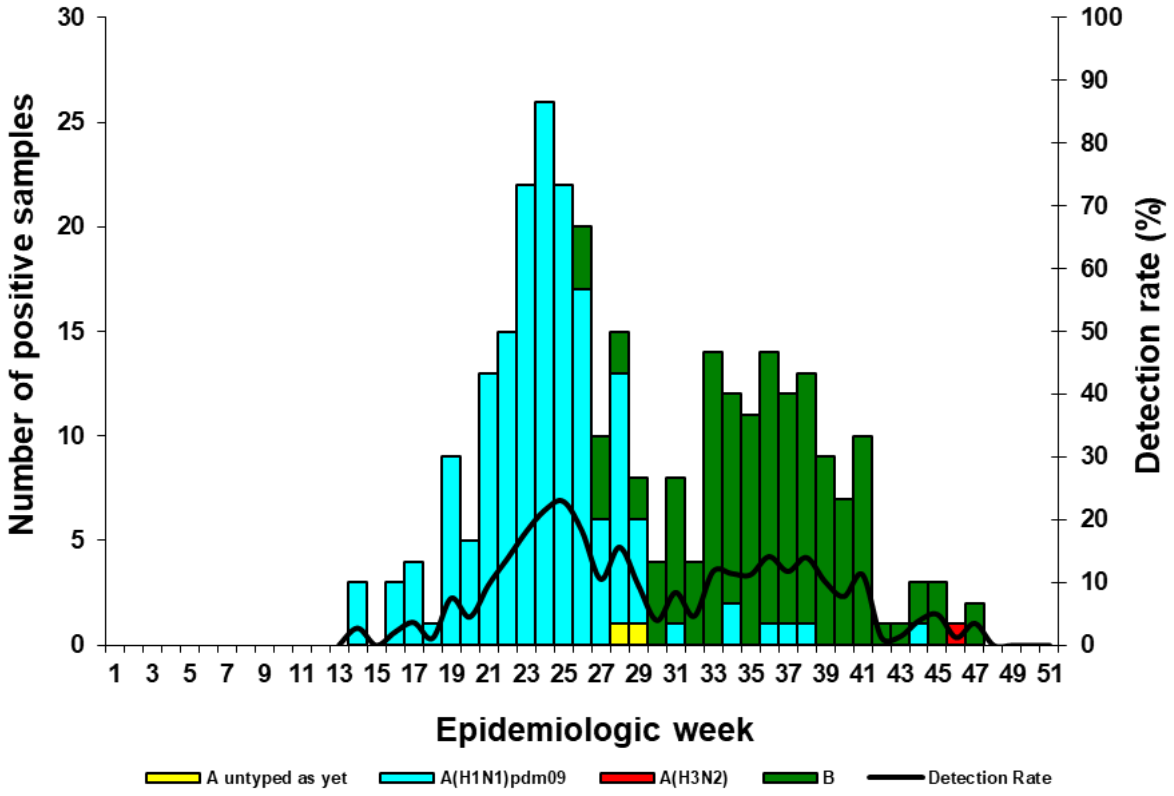

Figure 6: Numbers of samples positive for influenza and influenza detection rate, by type, subtype and week, in patients enrolled into the pneumonia surveillance programme and meeting the case definition of severe respiratory illness (SRI) in South Africa, 2018.

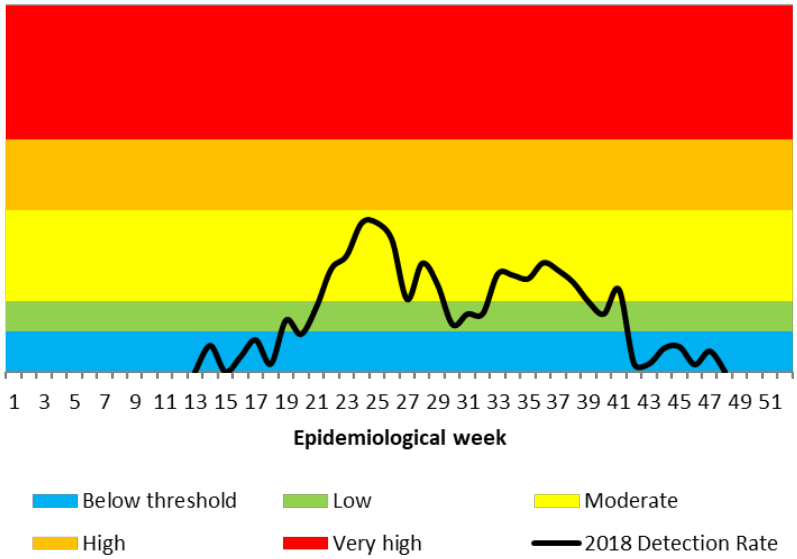

Figure 7: The impact of influenza based on the pneumonia surveillance programme influenza detection rate, South Africa, 2018. Thresholds are based on 2010 – 2017 data.

Respiratory syncytial virus

Systematic ILI programme

RSV circulation in the systematic ILI programme started in week 2 with the season threshold being reached by week 6. The overall detection rate was 7% (50/720), with a peak detection rate of 36% (3/8) in week 7. No positive samples were collected after week 25 (Figure 8).

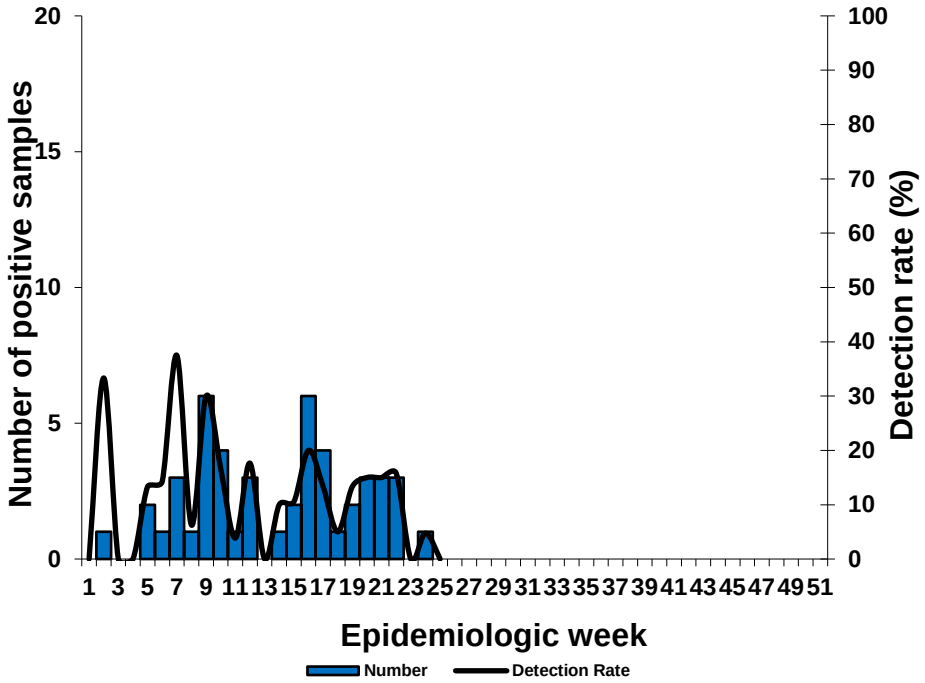

Figure 8: Detection rate of respiratory syncytial virus (RSV) by week in patients enrolled with influenza-like illness (ILI) at two primary health clinics, South Africa, 2018.

The pneumonia surveillance programme

RSV was detected from week one in the pneumonia surveillance programme. The overall detection rate was 18% (820/4630). The seasonal threshold was detected in week 7; the highest detection rate of 52% (51/98) was in week 18. The season ended in week 29 although RSV was detected throughout the year (Figure 9).

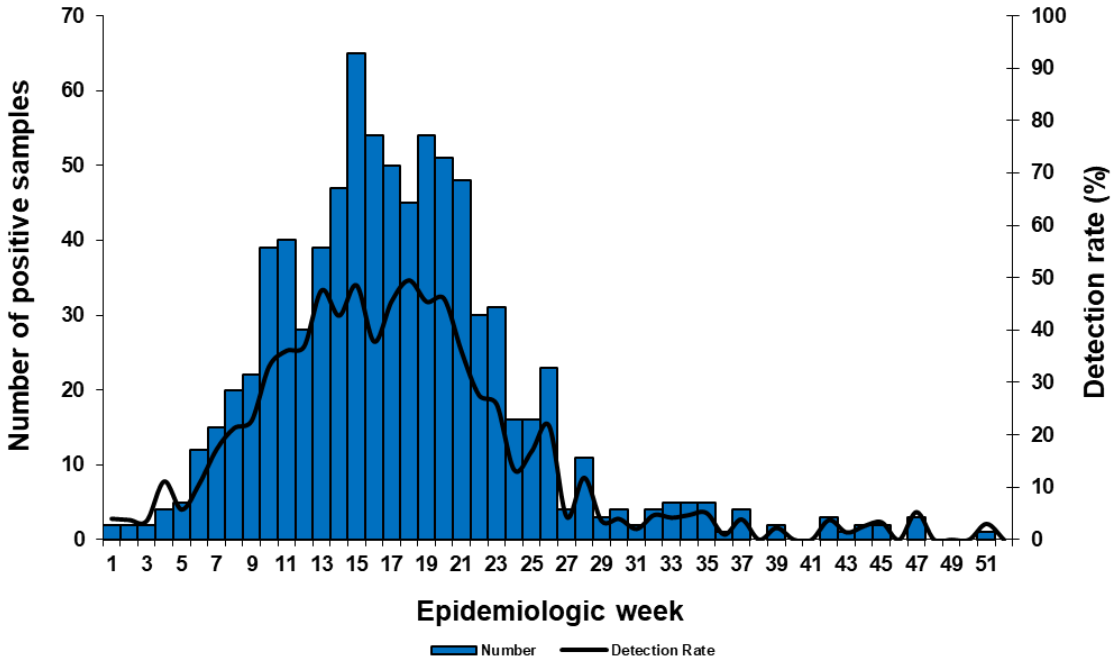

Figure 9: Numbers of samples collected and detection rates for respiratory syncytial virus (RSV), in patients meeting the case definition for severe respiratory illness (SRI), pneumonia surveillance, South Africa, 2018.

Bordetella pertussis

Systematic ILI programme

Pertussis cases were detected throughout the year in the ILI surveillance programme with the highest detection rate being 8% (5/59) in August 2018. Over 80% (81%; 13/16) of cases were detected at the Klerksdorp site (Jouberton Clinic) (Figure 10).

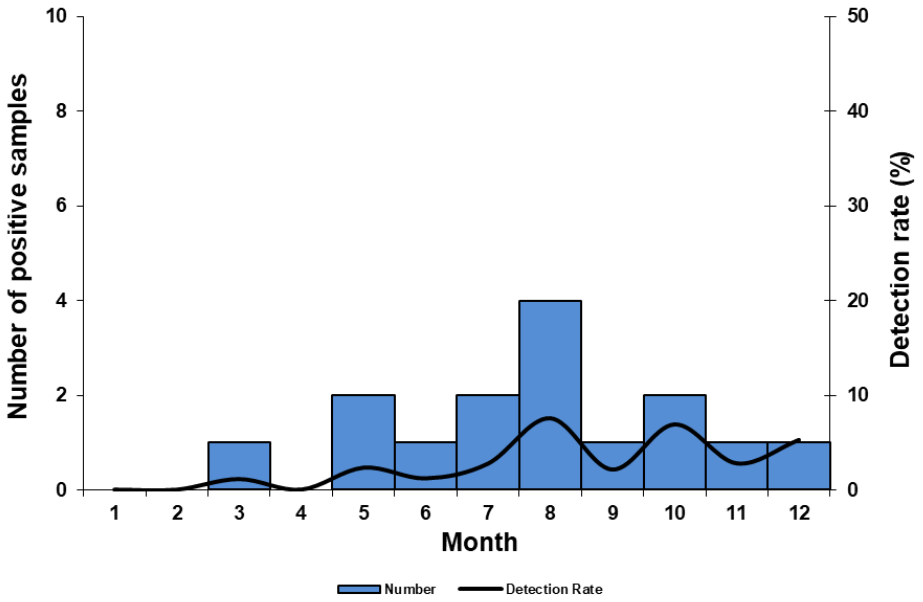

Figure 10: Numbers of positive samples for *Bordetella pertussis* among patients enrolled with influenza-like illness (ILI) at two primary health clinics, South Africa, 2018.

Pneumonia surveillance

The detection rate for pertussis in SRI cases was 2% (98/4630), and cases were detected all year. The peak detection rate was in July at 5% (20/420). Nearly half the cases (40%; 46/114) were identified at the RCH/MPH (Figure 11). Pertussis detection was more widespread in 2018 compared to 2017. This increase in pertussis detection was reported on the NICD webpage in August 2018. http://www.nicd.ac.za/wp-content/uploads/2018/08/PertussisAlert_2018-08-08.pdf

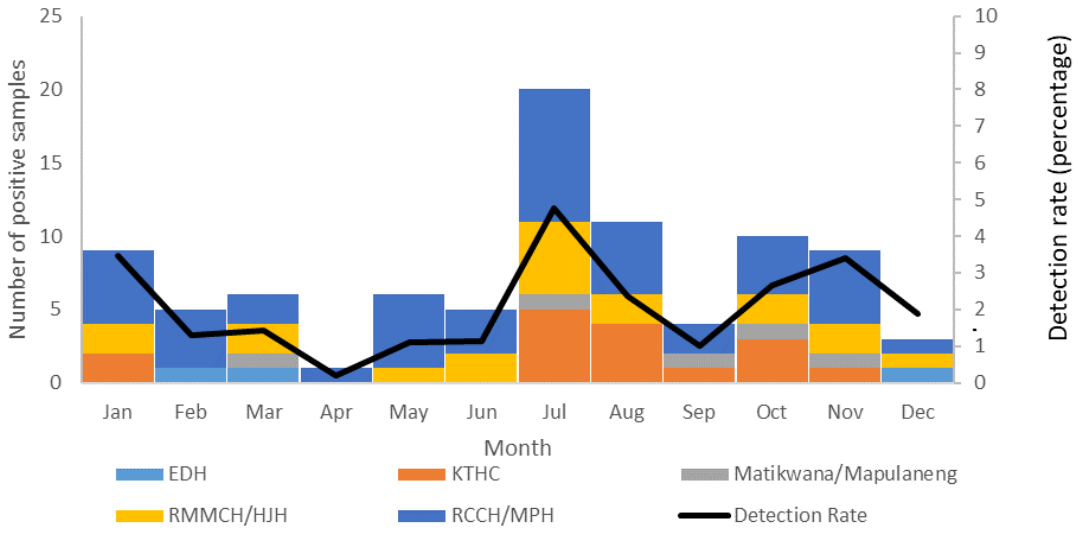

Figure 11: Detection rate and number of samples positive for *Bordetella pertussis* by site and month, among patients with severe respiratory illness (SRI), pneumonia surveillance programme, South Africa, 2018.

Respiratory morbidity surveillance

During 2018 there were 1 149 399 consultations reported to the NICD through the respiratory morbidity data mining surveillance system. Of these, 25 545 (2%) were due to pneumonia or influenza (P&I) (International Classification of Diseases 10 codes J10-18). There were 18 508 (72%) inpatients and 7 037 (28%) outpatients with P&I discharge data. An increase in P&I consultations and admissions was observed during the period with a higher number of seasonal influenza virus isolations reported to the viral watch and pneumonia surveillance programmes respectively (Figures 12 and 13). A second lower peak preceded the influenza season, corresponding to the circulation of respiratory syncytial virus.

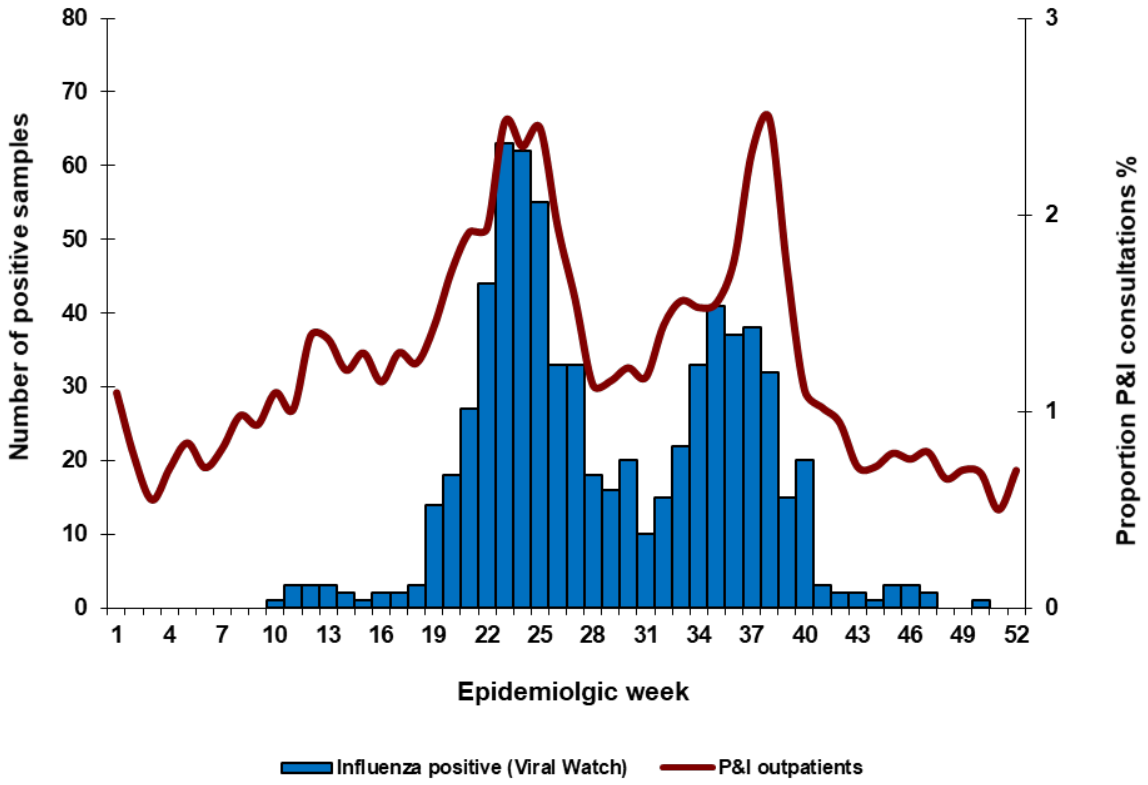

Figure 12: Numbers of private hospital outpatient consultations with a discharge diagnosis of pneumonia and influenza (P&I), and numbers of influenza positive viral isolates (Viral Watch) by week, South Africa, 2018.

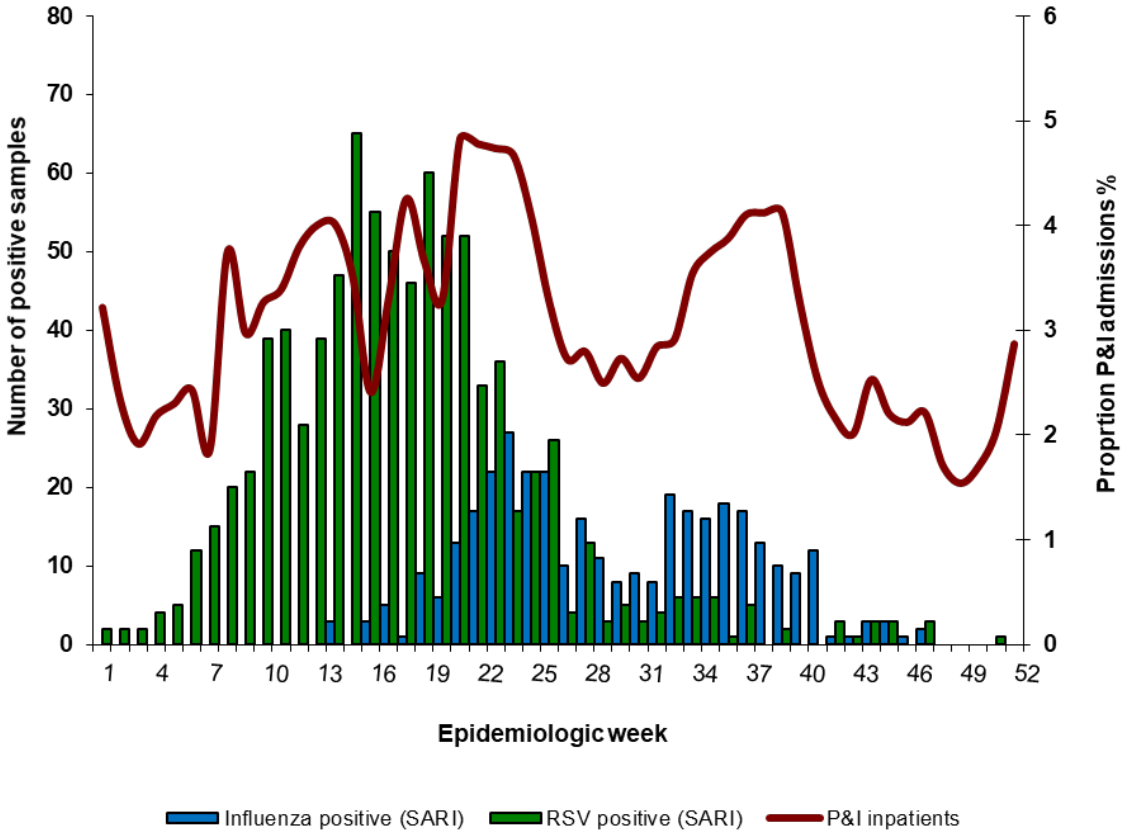

Figure 13: Numbers of private hospital admissions for pneumonia and influenza, as well as numbers of influenza positive viral isolates and respiratory syncytial virus (RSV) positive isolates by week, South Africa, 2018.

Virology of circulating influenza viruses and vaccine effectiveness (VE), 2018 influenza season

In all three surveillance programs influenza A(H1N1)pdm09 viruses were detected as the dominant circulating strain. Both influenza B/Victoria and B/Yamagata lineage viruses circulated and were detected at frequencies of 68% (313/460) and 21% (95/460), respectively. The influenza B lineage could not be determined in 11% (52/460) cases. Cell culture-derived influenza virus isolates were obtained with a 75% (157/208) success rate. Influenza A(H1N1)pdmo9 viruses (99%, 124/125) were typed as A/Michigan/45/2015-like with normal reactivity. A two-fold or greater reduction in hemagglutination inhibition titre against relevant vaccine strain antisera was observed at frequencies of 19% (3/16) for B/Yamagata virus isolates and 100% (6/6) for B/Victoria virus isolates.

Of the 1 465 individuals enrolled in viral watch and tested during the influenza season, 1 186 (81%) were eligible for the vaccine effectiveness (VE) analysis. The influenza detection rate was 54% (642/1186) amongst individuals included. The majority of influenza detections were A(H1N1)pdm09

which accounted for 365/642 (57%) of the total number of subtypes. These were followed by influenza B which accounted for 256 (40%) of detections with the remainder being influenza A(H3N2). The influenza vaccine coverage was 4.7% (30/642) in cases and 8.6% (47/544) in controls. Coverage in patients with underlying conditions was 12.4% (11/89) in cases and 20.7% (22/106) in controls, and in those aged ≥65 years was 25% (5/20) in cases and 33% (10/30) in controls. The overall VE estimate, adjusted for age and seasonality, was 51.3% (95% CI: 10.5% to 73.5%) against any influenza virus type. Against influenza A(H1N1)pdm09 it was 56.9% (95% CI 18.7% - 77.2%) in all patients, and 70.6% (95% CI 33.2% - 87.0%) in adults aged between 18 and 64 years (adjusted for seasonality only). Vaccine effectiveness against influenza B, adjusted for age and seasonality, was 14.3%
(95% CI: -120.1% - 66.6%).

Discussion

The 2018 influenza season in South Africa was predominated by influenza A(H1N1)pdm09 with co-circulation of influenza B (influenza B/Victoria and B/Yamagata) and sporadic influenza A(H3N2) cases. In all the surveillance programmes, circulation in the initial period of the season was almost exclusively influenza A(H1N1)pdm09 with influenza B predominating during the last weeks of the season. The season onset was within the average onset period compared to previous years in which the mean onset was week 22 (range 17-28)[1]. The 2018 season as measured by the Viral Watch Programme was 24 weeks long, and within the range described over the last 30 years (range 7-25). The influenza vaccine was effective in South Africa against influenza A(H1N1)pdm09 in 2018. Additional information from this surveillance programme including information on the risk groups for severe illness[2,3], annual estimates of influenza vaccine effectiveness [4-6], and details of virus characterisation are presented in different reports and complement the information presented here.

The RSV season preceded the influenza season, starting in week 7 at the ILI sites and in week 8 at the pneumonia surveillance sites. There was no obvious seasonality identified for *B. pertussis*. The surveillance programme identified an increase in pertussis cases from all sites, prompting alerts to be circulated to all sentinel sites nationally. These alerts urged clinicians to adopt a high index of suspicion for pertussis and initiate early treatment and public health action.

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