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Division of the National Health Laboratory Service

2023 GERMS-SA: ANNUAL SURVEILLANCE REVIEW

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2023

GERMS-SA: ANNUAL SURVEILLANCE REVIEW

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INTRODUCTION

The GERMS-SA surveillance platform, co-ordinated by the National Institute for Communicable Diseases (NICD), remains a critical part of tracking and monitoring infectious diseases across South Africa. In 2023, GERMS-SA continued its mission to provide pathogen-specific data on a range of diseases and support public health decision-making through reliable laboratory-based surveillance. The annual review reflects the activities undertaken during this period, highlighting the achievements, data outcomes, and collaborations that have been central to these efforts. Despite these successes, the year also brought several challenges, including data inconsistencies, laboratory delays, and operating at reduced capacity due to unfilled positions resulting from cost-containment policies. The number and viability of isolates received by NICD reference laboratories continued to be negatively affected, resulting in the inability to perform antimicrobial susceptibility testing and serotyping/serogrouping on the missing isolates. While case patient notification reports from the Surveillance Data Warehouse (SDW) and Notifiable Medical Conditions (NMC) helped address some of these challenges, there is still a need for improved co-ordination and communication between GERMS-SA and participating laboratories.

Looking ahead, GERMS-SA is committed to refining its processes, optimising its collaborations, and improving data quality and timeliness. We urge all microbiology laboratories, in their challenged capacities, to continue to participate in laboratory surveillance so monitoring can continue and strengthen the network's capacity to respond to emerging public health threats. We thank you for your ongoing service to the health of all South Africans.

METHODS

In 2023, diseases under surveillance included:

1. Opportunistic infections associated with HIV, e.g., cryptococcosis and invasive pneumococcal disease (IPD).
2. Epidemic-prone diseases, e.g., *Neisseria meningitidis, Salmonella enterica* serotype Typhi, *Salmonella enterica* serotype Paratyphi A, B, and C, Nontyphoidal *Salmonella* species, *Shigella* species, *Vibrio cholerae,* Diarrhoeagenic *Escherichia coli, Campylobacter* species, *Listeria* species, and *Streptococcus pyogenes.*
3. Vaccine-preventable diseases, e.g., *Haemophilus influenzae* type b (Hib), *Streptococcus pneumoniae,* and *Streptococcus agalactiae.*
4. Healthcare-associated bloodstream infections caused by ESKAPE organism *Escherichia coli.*

The methods applied by the GERMS-SA surveillance programme have been previously described in detail (1).
In brief, approximately 222 South African clinical microbiology laboratories participated in the surveillance programme in 2023. The estimated population under surveillance in 2023 was at 62.2 million (Table 1). Diagnostic laboratories reported case patients to the NICD using laboratory case report forms, according to standard case definitions. If available, isolates from case patients were submitted on Dorset transport media to the NICD for further phenotypic and genotypic characterisation. From 1 July 2008 to 31 December 2013, surveillance methodology for the cryptococcal project was changed, so that only enhanced surveillance sites (ESS) (29 hospitals in 9 provinces), NHLS laboratories in KwaZulu-Natal province, and laboratories in the private, mining, and military sectors were required to send cryptococcal isolates to NICD. All other cases of cryptococcosis were detected through the NHLS Surveillance Data Ware-house (SDW), which stores information from Disa*Lab and TrakCare laboratory information systems. Cryptococcal isolates, obtained from patients at enhanced surveillance sites, continued to be characterised by phenotypic and genotypic tests through 2013. Between 2015 and 31 July 2022, no isolates were collected and all cryptococcal cases were detected through the NHLS SDW. From 1 September 2022, *Cryptococcus* surveillance for flucytosine susceptibility testing started. *Cryptococcus* isolates from all NHLS laboratories with flucytosine access sites and all Western Cape Province NHLS laboratories were submitted to the NICD. For this annual report, only cryptococcal data from the current and immediate previous year(s) were analysed. Thus, some fraction of cases reported as incidents in these 2 years might be misclassified because they were not cross-checked against a line list of individuals who had cryptococcal meningitis, other culture-positive cryptococcal disease, or antigenaemia in the years prior to the analysis period. This could lead to an overestimation of the disease incidence in these 2 years.

Between April 2023 and September 2023, the Centre for Healthcare-Associated Infections, Antimicrobial Resistance and Mycoses (CHARM), performed an enhanced surveillance and laboratory investigation of extra-intestinal pathogenic *Escherichia coli* (ExPEC) isolates from sterile sites to include epidemiological, prevalence of antimicrobial resistance (AMR), and pathogenicity analysis.

Enhanced surveillance (ES) was not conducted on any of the enteric pathogens in 2015; however, ES was restarted in 2016 for *Salmonella* Typhi, and in 2019 for Nontyphoidal *Salmonella* species and *Salmonella enterica* serotype Paratyphi A, B, and C. The Centre for Enteric Diseases runs the active surveillance programme on enteric fever, listeriosis, and cholera, which are classified as Category 1 Notifiable Medical Conditions (NMCs). Reporting of all cases through the NMC platform by healthcare workers and laboratorians is mandatory, and every notification is followed up by the centre team. For each case, this includes contacting the diagnostic laboratory to facilitate referral of isolate(s) and contacting relevant healthcare professionals or Department of Health officials to facilitate completion of specific case investigation forms. GERMS-SA surveillance officers at enhanced surveillance sites (ESS) assisted with completing the NMC case investigation forms for cases identified at their sites.

For 2023, at ESS (30 hospitals in 9 provinces), surveillance officers completed clinical case report forms electronically using the REDCap database, on tablets, for patients with eleven laboratory-confirmed diseases: cryptococcosis, extra-intestinal pathogenic *Escherichia coli* (in four provinces), invasive pneumococcal disease, invasive meningococcal disease, invasive *Haemophilus influenzae* disease, invasive Group A Streptococcus disease, invasive Group B Streptococcus disease, invasive *Salmonella* Typhi disease, Paratyphi A,B,C, Nontyphoidal diseases (country-wide), and Listeriosis by case patient interview or hospital medical record review, to obtain additional clinical details, in-cluding antimicrobial use, vaccination history, HIV status, and patient outcome. Case patients were followed up only for the duration of the hospital admission. Data management was centralised at the NICD. Laboratory, clinical, and demographic data from case patients were recorded on a Microsoft Access database. A surveillance audit was performed for NHLS laboratories in all provinces using the NHLS CDW. For all diseases under surveillance, except cryptococcosis, the audit was designed to obtain basic demographic and laboratory data from additional case patients with laboratory-confirmed disease not already reported to GERMS-SA by participating laboratories. Data from case patients, detected by audit, were included on the surveillance database and have been included in this report. Incidence was calculated using mid-year population estimates for 2022 and 2023 from Statistics South Africa (Table 1) (2). Incidence in the HIV-infected and AIDS populations was calculated for 2022 and 2023 using the Thembisa Model; Johnson LF, et al., (2022); The effect of HIV programmes in South Africa on national HIV incidence trends, 2000-2019; Journal of Acquired Immune Deficiency Syndromes, 90: 115-123 (Table 1) (3). All reported incidence is expressed as cases per 100 000 population, unless otherwise stated. Reported p-values were calculated using the Mantel-Haenszel chi-squared test, and p values <0.05 were considered significant throughout. Ethics approval for the ongoing activities of the surveillance programme was obtained from the Human Research Ethics Committee (Medical), University of Witwatersrand, and from relevant University and Provincial Ethics Committees for other enhanced surveillance sites. Surveillance activities were funded by the NICD/NHLS.

Table 1. Population denominators used to calculate incidence rates, South Africa, 2022 and 2023

Province	General population*		HIV-infected population**	
	2022	2023	2022	2023
Eastern Cape	6 676 691	7 150 858	871 928	880 306
Free State	2 921 611	3 022 882	429 242	428 498
Gauteng	16 098 571	15 639 891	1 885 800	1 906 310
KwaZulu-Natal	11 538 325	12 161 867	1 981 840	1 975 690
Limpopo	5 941 439	6 335 306	703 442	715 780
Mpumalanga	4 720 497	4 984 096	752 213	753 263
Northern Cape	1 308 734	1 356 580	104 872	105 791
North West	4 186 984	4 091 587	537 458	541 410
Western Cape	7 212 142	7 437 324	517 333	530 089
South Africa	**60 604 992**	**62 180 391**	**7 784 128**	**7 837 137**

Data source: *Statistics South Africa, **Thembisa Model; Johnson LF, et al. (2022) The effect of HIV programs in South Africa on national HIV incidence trends, 2000-2019. Journal of Acquired Immune Deficiency Syndromes. 90: 115-123

OPERATIONAL REPORT

Site operations and challenges

In 2023, NICD staff continued conducting site visits and providing training at enhanced surveillance sites and laboratories; however, several operational challenges affected various sites. In January, Klerksdorp/Tshepong complex in North West ran out of reagents, and Chris Hani Baragwanath Academic Hospital, along with other laboratories, continued to face shortages of essential items like Mueller Hinton, chocolate, and 5% sheep blood agar plates. Severe weather in Durban led to the flooding in the medical records room at RK Khan Hospital, complicating access to records. Many smaller sites reported a slow start to the year, with fewer lab-confirmed cases than expected. Planned renovations at Rahima Moosa Hospital in May 2023 disrupted patient flow, with admissions redirected to Discovery and Nelson Mandela Children's Hospitals. Similarly, renovations at the Helen Joseph Hospital NHLS laboratory, initiated in June 2023, remain incomplete. Staffing challenges due to resignations and frozen positions posed additional difficulties, while cost-saving measures limited travel and in-person surveillance officer (SO) meetings, shifting them to virtual platforms like Zoom. Significant personnel changes included the resignation of a roving technician, two SOs, one Field Project Co-ordinator, and the termination of contracts for one SO and one Research Assistant.

Co-ordination of meetings

In 2023, GERMS-SA staff involved in respiratory syndromic sentinel surveillance attended a training workshop from 25-27 October at the Birchwood Conference Centre, Johannesburg. The objective was to refresh, update, and train staff on standardised procedures while enhancing quality control practices. Similarly, GERMS-SA lab-based surveillance staff attended virtual training sessions over the Zoom platform on 6–8 December 2023. These workshops focused on addressing common errors, standardising procedures, and improving quality control of the data.

Surveillance audit

A total of 14 138 surveillance cases were detected by GERMS-SA in 2023. Excluding the cases of cryptococcosis (n=4278), which are all detected by audit, 3268/9860 (33%) of cases were detected by audit of the NHLS Corporate Data Warehouse (Table 2) and isolates not sent to the NICD by the clinical microbiology laboratories (excluding *Cryptococcus* spp.) GERMS-SA constantly strives to reduce the number of cases detected on audit by raising awareness of the surveillance programme; this is important because GERMS-SA is unable to perform additional microbiological characterisation of isolates detected only through audit.

Table 2. Cases detected by surveillance audit by province, 2023

Surveillance case		Percentage of cases detected by audit* n_1/n_2 (%)	Number of cases detected by audit									
			EC	FS	GA	KZ	LP	MP	NC	NW	WC	SA
Invasive	Cryptococcosis**	4278/4278 (100)	720	135	918	976	306	310	54	312	547	4278
	Escherichia coli	827/1609 (51)	-	21	544	100	-	-	-	-	162	827
	Non-typhoidal salmonellosis†	225/1033 (22)	19	8	117	42	3	7	2	3	14	225
	Shigellosis	12/42 (29)	1	0	5	5	0	0	0	0	1	12
	Meningococcal disease	7/107 (7)	0	0	2	0	0	0	2	0	3	7
	Haemophilus influenzae disease	100/301 (33)	70	28	149	76	14	15	11	37	55	455
			4	3	26	19	6	3	3	4	32	100
	Pneumococcal disease	455/1807 (25)	70	28	149	76	14	15	11	37	55	455
	Streptococcus pyogenes	394/919 (43)	27	18	162	44	8	12	6	7	110	394
	Streptococcus agalactiae	566/1003 (56)	18	21	284	135	15	24	5	22	42	566
Non-invasive	Non-typhoidal salmonellosis†	495/2129 (23)	66	26	140	121	27	25	6	35	49	495
	Shigellosis	187/910 (21)	29	9	27	60	4	6	2	7	43	187
	Total (excl crypto)	3268/9860 (33%)										

Percentage of cases detected by audit = number of cases detected on audit (n1)/total number of cases detected by GERMS-SA (n2) x 100;**All cases of cryptococcal disease are detected by LIS audit and no isolates are received; therefore this disease is excluded from the total; †Excludes cases of *Salmonella enterica* serovars Typhi, and serovars Paratyphi A, B and C; EC: Eastern Cape; FS: Free State; GA: Gauteng; KZ: KwaZulu-Natal; LP: Limpopo; MP: Mpumalanga; NC: Northern Cape; NW: North West; WC: Western Cape; SA: South Africa; BC: Blood culture.

Enhanced surveillance site performance indicators

The proportion of completed CRFs was higher than that in 2022. Although restrictions to the records department were relaxed and surveillance officers were conducting face-to-face interviews with patients, poor record systems in many hospitals were still an issue. Some patients were discharged or referred to another facility with their records, leaving the original facility without complete documentation (Table 3); 4408/4852 (91%) of cases had a case report form (CRF) completed (target=90%). Delays in identifying eligible patients and limited follow-up opportunities at sites impacted heavily on consenting and interview rates. A total of 1956 (44%) CRFs were completed through patient interviews, falling short of the 70% target.

Since 2007, enhanced surveillance site operational reports (ESSOR) have been provided to the site co-ordinators, laboratory staff, and surveillance officers to enable the site team to regularly review site performance in comparison with set targets. The main objective of these reports is to provide information regarding the overall functioning of the surveillance site by providing indicators of laboratory participation (submission of isolates) and indicators of surveillance officer performance (completion of CRFs). By reviewing these indicators, problems with data collection can be targeted, and recommendations are provided to improve the site performance.

Table 3. Enhanced surveillance site performance indicators, 2023

Enhanced surveillance site	Case patients, n	Completed case report forms*, n (%)**		Case report forms completed by interview, n (%)***	
Addington [1]	52	50	96	24	48
Charlotte Maxeke Johannesburg Academic [1]	491	467	95	237	51
Chris Hani Baragwanath/ Zola-Jabulani District [1]	904	799	88	324	41
Dr George Mukhari [1]	216	205	95	110	54
Edendale/ Greys'/ Northdale [1]	295	288	98	165	57
Groote Schuur/ Red Cross [1]	525	485	92	220	45
Helen Joseph/ Rahima Moosa Mother & Child [1]	508	459	90	198	43
Kimberley	53	32	60	4	13
King Edward VIII/ Inkosi Albert Luthuli Central Hospital [1]	140	134	96	55	41
Klerksdorp/ Tshepong	133	104	78	55	53
Mankweng/ Polokwane/ Seshego	139	129	93	58	45
Pelonomi/ Universitas [1]	166	146	88	73	50
Port Elizabeth/ Dora Nginza/ Livingstone	380	346	91	128	37
RK Khan [1]	180	156	87	66	42
Rob Ferreira/ Themba	88	82	93	33	40
Steve Biko Pretoria Academic/ Tshwane District [1]	236	197	83	75	38
Tygerberg [1]	346	329	95	131	40
Total	**4852**	**4408**	**91**	**1956**	**44**

Note - The percentage in each cell was calculated using the numerator from that cell and the corresponding denominator from the cell to the left; *Regular monitoring and feedback at sites can lead to increased report form completion rates by identifying common errors and areas for improvement, which helps motivate staff to maintain high standards. Patient interviews still low at certain sites due to delayed notifations therefore patients discharged/ demised before alert . Kimberley, shared post with NMC therefore most CRFs completed by medical reviews (which are a challenge to access); **Target = 90%; ***Target = 70%. [1]Sites doing *E. coli* surveillance

Enhanced surveillance site quality monitoring

In 2023, as per annual performance management and improving quality of data collection, SOs were audited in terms of quality of work. CRFs from a specific time period were randomly selected for each SO to allow auditing of CRFs for each organism on an individual basis. The medical record files were drawn, and the GERMS-SA co-ordinating staff filled in a modified clean CRF from the original source data and compared their CRF with the original SO CRF. A scoring system was set up, and although the scores varied widely amongst SOs, many of the errors were ones of omission and overlooking information rather than entry of incorrect data. Data training was done regularly to overcome these errors.

SURVEILLANCE REPORTS

Enhanced surveillance site project

In 2023, 4322 surveillance case patients were diagnosed at enhanced surveillance sites (Table 3). Of case patients with recorded HIV status, 44% (1544/3547) were HIV-infected (Table 4). The proportion of case patients with confirmed HIV infection varied by surveillance disease. Unsurprisingly, a very high proportion of patients with AIDS-defining infections like cryptococcosis (96%) were HIV-infected. HIV infection amongst patients with invasive pneumococcal disease, for which HIV is a known risk factor, was 53%.

Table 4. Numbers and percentage* of patients diagnosed with laboratory-confirmed invasive disease at GERMS-SA enhanced surveillance sites, with confirmed HIV-1 infection **, South Africa, 2023

Pathogen	Case patients, n	Case patients with completed case report forms, n (%)*		Case patients with known HIV status, n (%)		Case patients with confirmed HIV infection, n (%)**	
Cryptococcus species	861	782	91	749	96	716	96
Escherichia coli	1609	1567	97	1254	80	304	24
Neisseria meningitidis	24	18	75	18	100	5	28
Streptococcus pneumoniae^	717	648	90	629	97	334	53
Haemophilus influenzae^	142	126	89	115	91	30	26
Streptococcus pyogenes	481	422	88	396	94	110	28
Streptococcus agalactiae^	488	408	84	386	95	45	12
Total	**4322**	**3971**	**92**	**3547**	**89**	**1544**	**44**

*The percentage in each cell was calculated using the numerator from that cell and the corresponding denominator from the cell to the left. **HIV infection was confirmed by an age-appropriate, laboratory test and recorded by surveillance officers at enhanced surveillance sites. ^6 co-infections counted separately under each pathogen: 1 *Streptococcus pneumoniae* and *Streptococcus pyogenes* mixed episode, and 5 *Streptococcus pneumoniae* and *Haemophilus influenzae* mixed episodes

Cryptococcus species

Results

During 2023, 4601 episodes of laboratory-confirmed cryptococcal disease were reported. This included 4278 first episodes (among 4278 patients) and 323 recurrent episodes (among 158 patients) (Table 5). By comparison, 4743 episodes were detected in 2022, of which 4410 were incident and 333 were recurrent (among 248 patients). We excluded cases of cryptococcal antigenaemia (i.e., positive blood cryptococcal antigen test without concurrent meningitis, fungaemia, or culture-positive disease elsewhere) from these analyses.

A majority (n=4055, 95%) of the incident cases were diagnosed as cryptococcal meningitis (laboratory tests on cerebrospinal fluid positive for *Cryptococcus* species), 3% (n=148) as fungaemia (*Cryptococcus* species cultured from blood), and 2% (n=75) as culture-positive disease at other sites (Table 6). The national incidence risk of laboratory-confirmed cryptococcosis remained stable with 57 (95% CI 55-58) and 55 (95% CI 53-56) cases per 100 000 people living with HIV in 2022 and 2023, respectively (Table 7). Over these 2 years, incidence risks with overlapping 95% confidence intervals were noted in all provinces. Males accounted for 62% (2590/4207) of the cases, and the highest incidence risk was recorded among males aged 40-44 years. The peak incidence among females, though lower than for males, was among those aged 30-34 years, 35-39 years, and 40-44 years (Figure 1). Age was known for 3869 (90%) case patients; the median age was 38 years (interquartile range [IQR], 32-45 years), and children younger than 15 years accounted for 3% of cases (n=115).

There were 861 case patients with a first episode reported at ESS during 2023, and case report forms were completed for 91% (n=782). Among 749 patients with known HIV status, 96% (n=716) were HIV-seropositive. Nearly two-thirds of HIV-seropositive patients (56% [368/652]) had previously received antiretroviral therapy (ART) or were on antiretroviral treatment at the time of their cryptococcal disease diagnosis. The median CD4 cell count recorded close to the time of cryptococcal disease was 34 cells/µl (IQR, 13-73 cells/µl); 92% (584/631) had a CD4 cell count <200 cells/µl. Viral load test results were available for 511 patients; 24% (n=122) had a viral load of <400 copies/mL, 12% (n=61) had viral loads of 400–10 000 copies/mL, and 64% (n=328) had viral loads of >10 000 cop-ies/mL. Most of the case patients received antifungal therapy in-hospital (86%, 629/730); 61% (370/610) received a flucytosine-containing induction regimen. The in-hospital case-fatality ratio for patients at ESS with a first episode of cryptococcal disease was 38% (277/723). The in-hospital mortality was higher among individuals who did not receive a flucytosine-containing induction regimen (43% [99/232] compared to those who did (30% [112/378]).

Table 5: Number of incident and recurrent episodes of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA, South Africa, 2022-2023, n=9344

Year	Cases (incident episodes)	Cases with recurrent episodes	Total recurrent episodes*	Total episodes
2022	4410	248	333	4743
2023	4278	158	323	4601
Total	**8688**	**406**	**656**	**9344**

*Some cases had more than one recurrent episode.

Table 6: Number and percentage of cases of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA by specimen type, South Africa, 2022-2023, n=8688

Site of specimen	2022		2023	
	n*	%	n*	%
Cerebrospinal fluid	4308	98	4055	95
Blood	82	2	148	3
Other	20	0.5	75	2
Total	**4410**		**4278**	

*These case numbers exclude 2 285 patients (1 300 in 2022 & 985 in 2023) who tested positive for cryptococcal antigenaemia at NHLS microbiology labs.

Table 7: Number of cases and incidence of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA by province, South Africa, 2022-2023, n=8688

Province	2022		2023	
	n	Incidence rate*	n	Incidence rate*
Eastern Cape	700	80 (74-86)	720	82 (76-88)
Free State	167	39 (33-45)	135	32 (26-37)
Gauteng	998	53 (50-56)	918	48 (45-51)
KwaZulu-Natal	1050	53 (50-56)	976	49 (46-52)
Limpopo	358	51 (46-56)	306	43 (38-48)
Mpumalanga	282	37 (33-42)	310	41 (37-46)
Northern Cape	51	49 (35-62)	54	51 (37-65)
North West	280	52 (46-58)	312	58 (51-64)
Western Cape	524	101 (93-110)	547	103 (95-112)
South Africa	**4410**	**57 (55-58)**	**4278**	**55 (53-56)**

*These case numbers exclude patients who tested positive for cryptococcal antigenaemia.
†Incidence risk was calculated using mid-year population denominators determined by the Thembisa model and is expressed as cases per 100 000 HIV-infected persons (refer to Table 1).

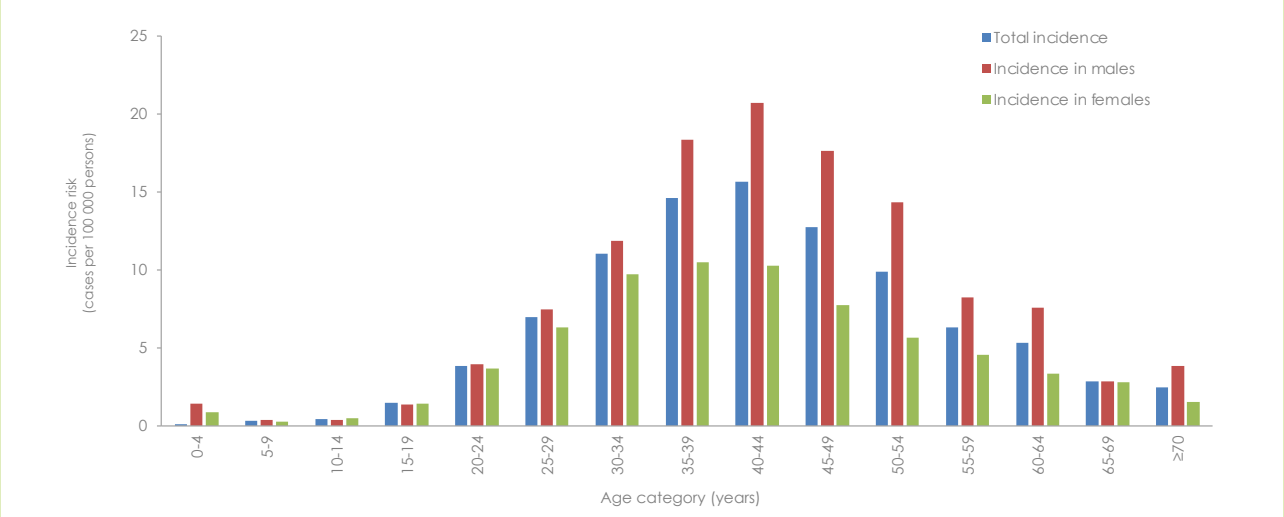

Figure 1. Number of cases and incidence of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA , by sex and age group, South Africa, 2022, n= 3869

Discussion

In 2023, the total number of episodes of cryptococcal meningitis and culture-confirmed cryptococcal disease, including recurrent disease, remained relatively stable in comparison to the previous year. Consequently, the healthcare system continues to have considerable burden, with a substantial number of patients requiring hospital admission on an annual basis for the management of cryptococcosis. The in-hospital mortality rate for patients at GERMS-SA ESS remained high in 2023, particularly among those who did not receive flucytosine-based induction therapy. Despite the recommendation of a one-week course of flucytosine and amphotericin B deoxycholate, followed by a week of high-dose fluconazole by the South African treatment guidelines, at least a third of patients did not receive flucytosine-containing regimens. Given the crucial role of flucytosine in reducing mortality, enhancing access to and promoting its use is of paramount importance.

Erratum for *Cryptococcus* species 2022 report:

After the publication of the 2022 annual report, an error was discovered in the reported number and proportion of patients receiving antiretroviral therapy.

The published statement was: "The majority of HIV-seropositive patients (90% [820/915]) had previously received antiretroviral therapy (ART) or were undergoing antiretroviral treatment at the time of their cryptococcal disease diagnosis."

The correct statement is: "A majority of HIV-seropositive patients (60% [497/828]) had previously received an-tiretroviral therapy (ART) or were on antiretroviral treatment at the time of their cryptococcal disease diagnosis."

E. coli

Results

There were 1609 cases of invasive *Escherichia coli* (as detected by a diagnostic laboratory) reported to GERMS-SA from April through to September 2023. During the six-month period, the majority of the cases were from the Gauteng province (58.4%; 940/1609), followed by KwaZulu-Natal province (19.8%; 319/1609) (Figure 2). Similar distributions were seen among males (50.2%; 808/1609) and females (49.4%; 796/1609). The median age of cases was 18 years (IQR: 18 years - 35 years), and 17.0% (273/1609) of cases were aged 31-40 years (Figure 3). Approximately 52.8% (849/1609) of cases had *E. coli* isolated from blood culture, followed by 17.3% (278/1609) from fluid aspirate (Figure 4). Infection origin was known for 90.9% (1463/1609) of cases. Community-origin infections accounted for 56.8% (831/1463) and 43.2% (632/1463) for hospital-acquired infections. Differences were observed for antimicrobial susceptibility patterns (obtained from the surveillance data warehouse at the NICD). *Escherichia coli* isolates of community origin were more susceptible to clinically relevant antimicrobial agents compared to isolates of hospital origin. For the β-lactams+β-lactamase inhibitors, 72.8% and 89.8% of the isolates tested from community-acquired isolates were susceptible to amoxicillin-clavulanic acid and piperacillin-tazobactam compared to 61.8% and 78.1% from the hospital-acquired isolates, respectively. For the fluoroquinolone ciprofloxacin, 71.4% of community-acquired isolates were susceptible, compared to 61.8% of the hospital-acquired isolates. For the third- and fourth-generation cephalosporins, 74.4%, 77.1%, and 79.3% of community-origin isolates were susceptible to cefotaxime/ceftriaxone, ceftazidime, and cefepime compared to 66.6%, 70.0%, and 72.9% of hospital-acquired isolates, respectively. For the carbapenem, ertapenem, 96.8% of community-acquired isolates were susceptible compared to 92.4% of hospital-acquired isolates (Figure 5). Known HIV status was available for 80% (1254/1567) of cases, of which 24.2% (304/1254) were HIV-positive (Table 4). Known 30-day clinical outcome was available for 88.8% (1393/1567) of cases, of which 26.8% (373/1393) died. Of the total number of cases, 48.6% (782/1609) of isolates were submitted to the NICD, of which 97.5% (763/782) were viable. Molecular testing was performed on a proportion of viable isolates based on complete case report forms, known 30-day clinical outcome, and antimicrobial susceptibility profiles to third- and fourth-generation cephalosporins and carbapenems. Of the selected 171 isolates resistant to cefotaxime/ceftriaxone, 28 isolates were PCR-positive for the tested ESBL genes, and 12.2% (21/171) were positive for TEM (Figure 6). Of the selected 41 isolates resistant to both cefotax-ime/ceftriaxone and ertapenem, 38 isolates were PCR-positive for the tested CPE genes. Of the 38 isolates, 82.9% (3/41) were positive for OXA-48 and variants, and 9.7% (4/41) were positive for NDM (Figure 7).

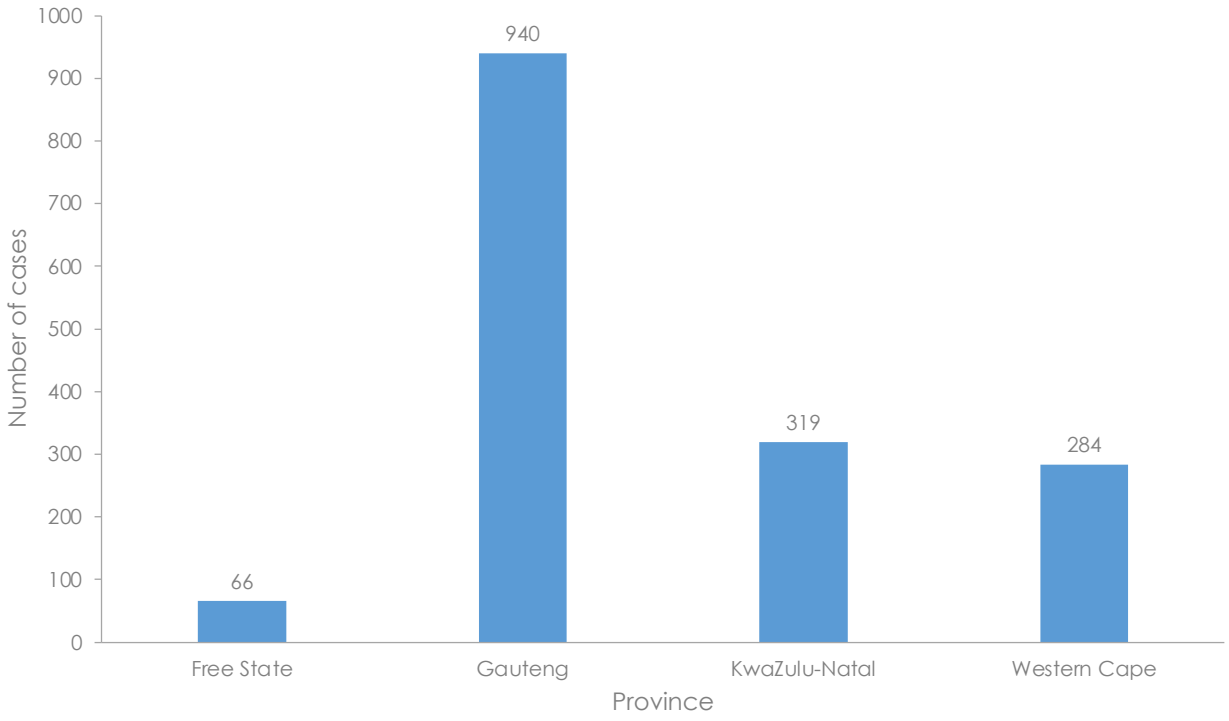

Figure 2. Distribution of invasive *Escherichia coli* cases by province, April to September 2023, n= 1609

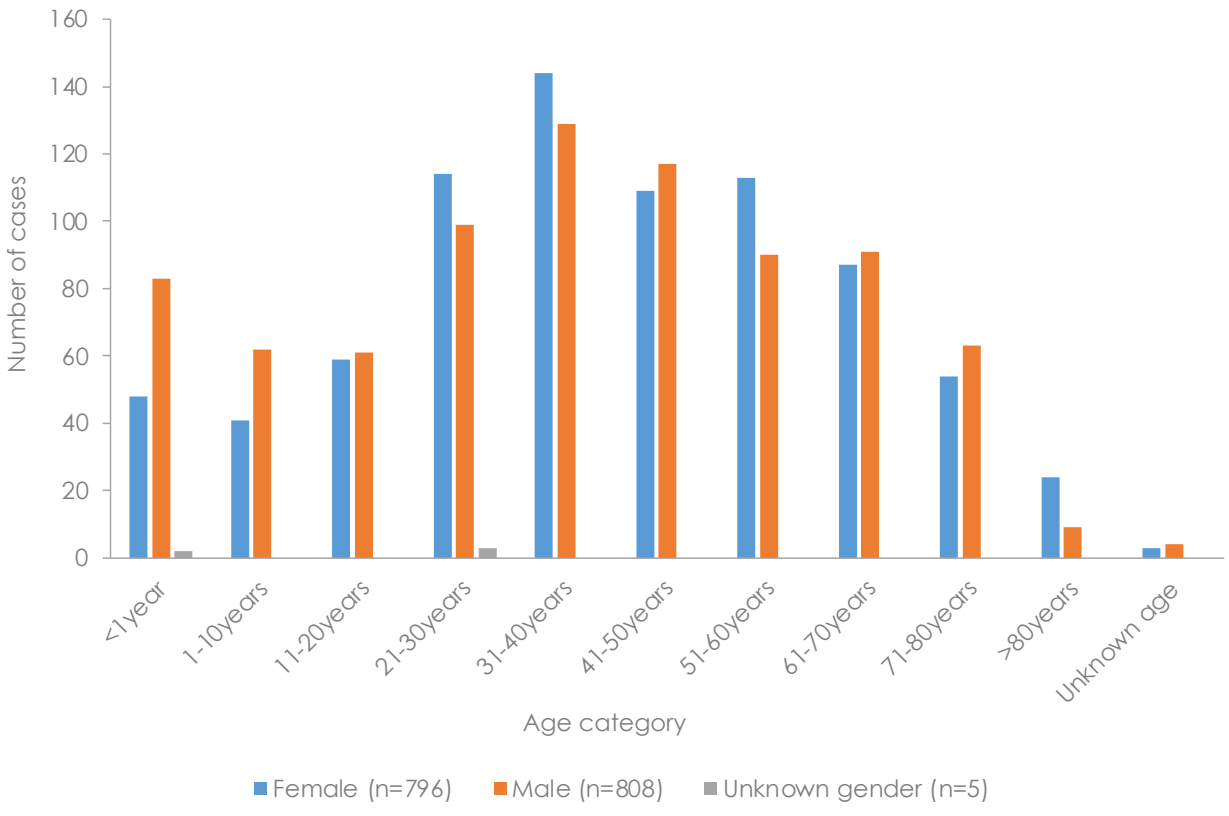

Figure 3. Distribution of invasive *Escherichia coli* cases by age and gender, April to September 2023, n= 1609

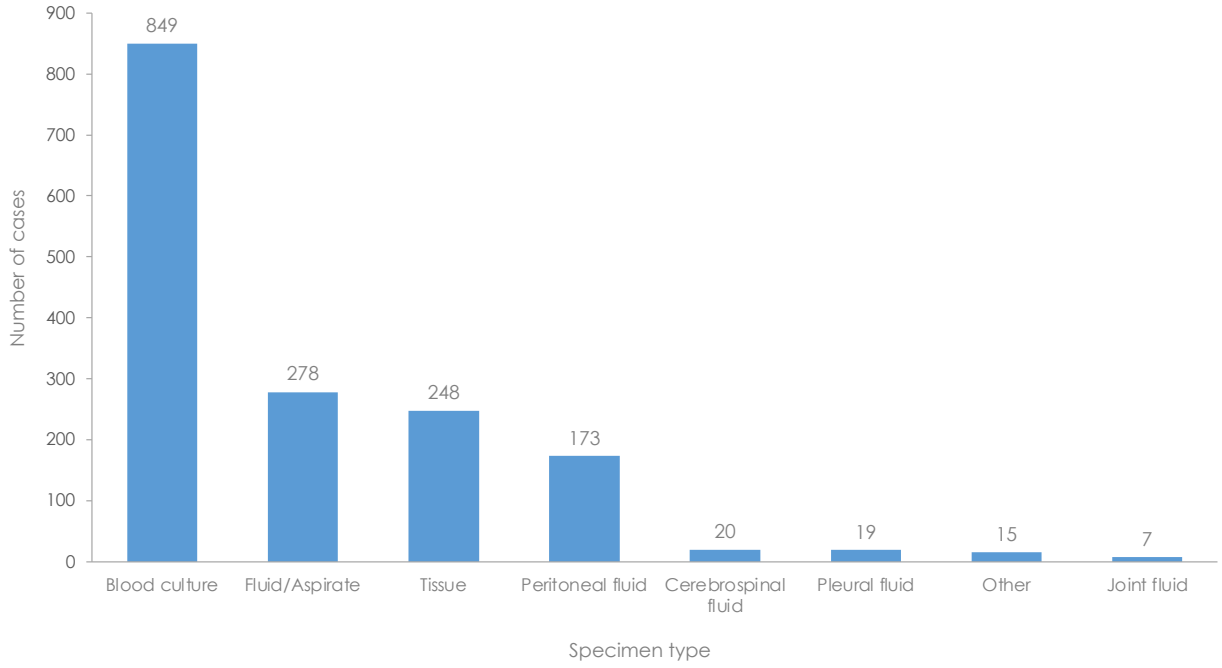

Figure 4. Distribution of invasive *Escherichia coli* cases by specimen type, April to September 2023, n= 1609

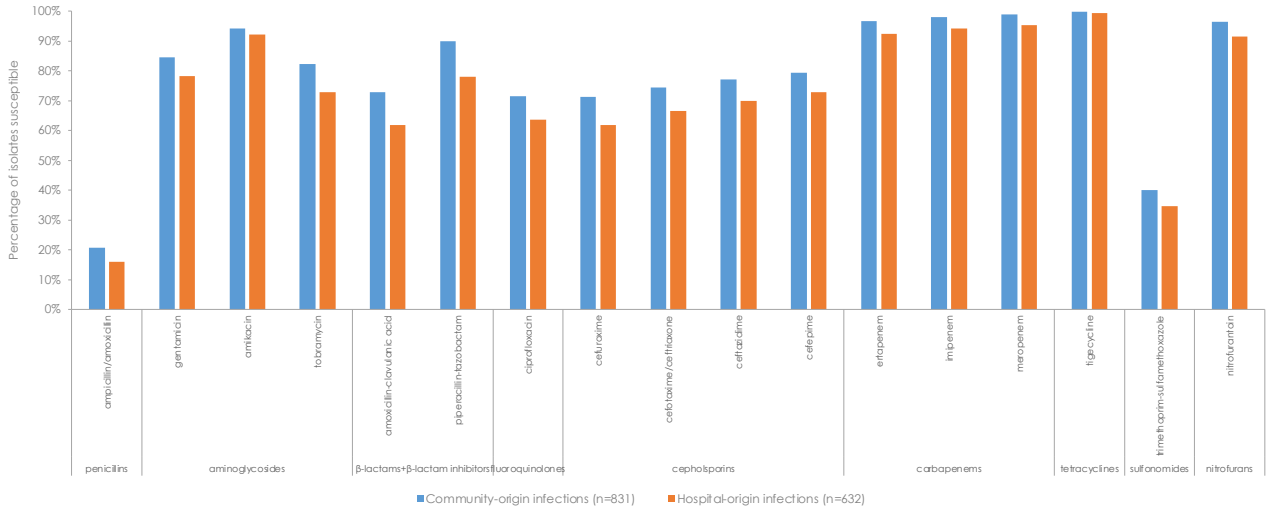

Figure 5. Antimicrobial susceptibility pattern of invasive *Escherichia coli* isolates by infection origin, April to September 2023, n= 1463

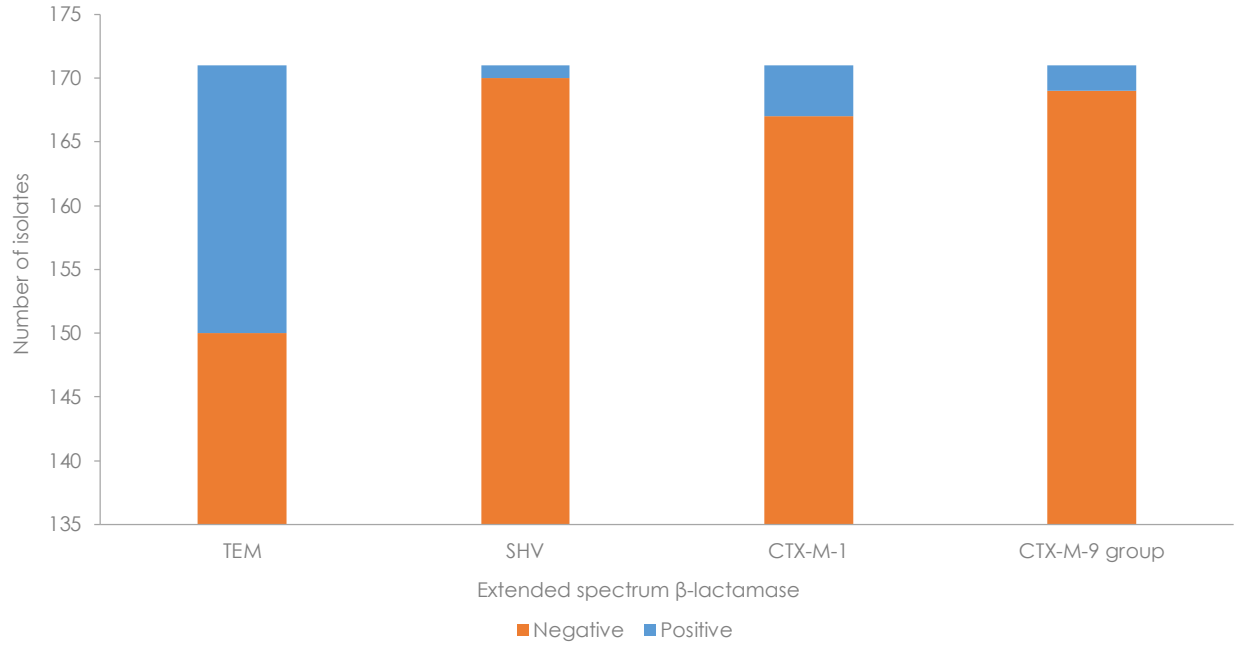

Figure 6. Distribution of extended spectrum β-lactamase genes in a proportion of invasive *Escherichia coli* isolates resistant to cefotaxime/ceftriaxone, April to September 2023, n= 171

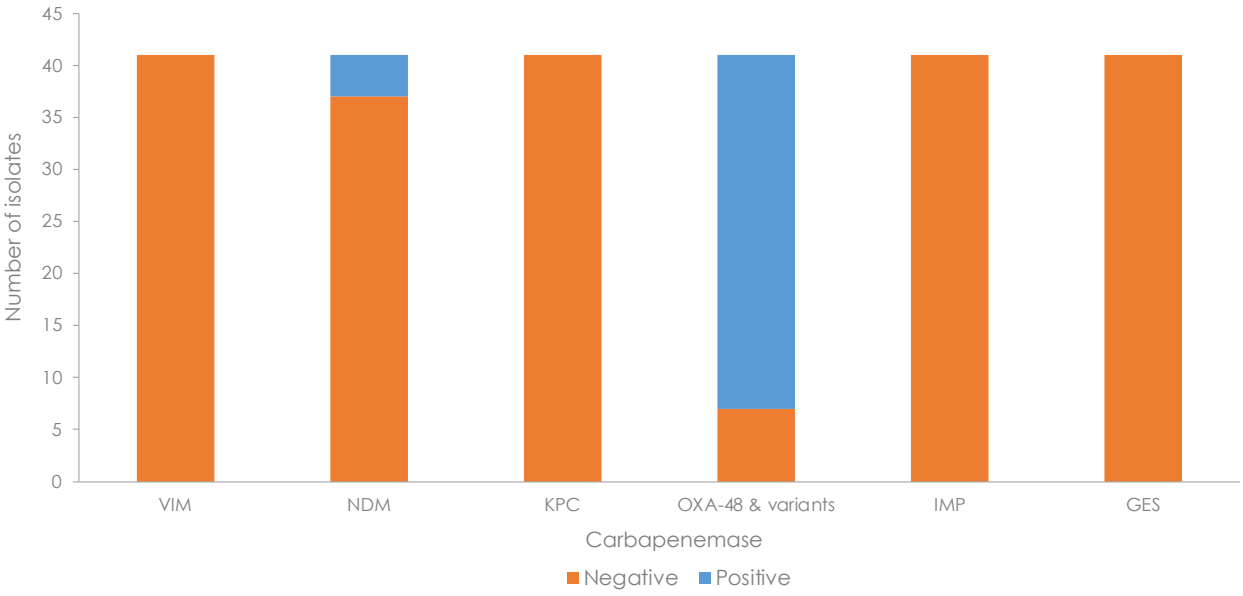

Figure 7. Distribution of carbapenemase genes in a proportion of invasive *Escherichia coli* isolates resistant to cefotaxime/ceftriaxone and ertapenem, April to September 2023, n= 41

Discussion

Most of the *E. coli* cases were detected in Gauteng and KwaZulu-Natal provinces. More than half of the cases were isolated from the bloodstream. Furthermore, more than one-third of the cases were hospital-acquired, and their corresponding isolates had lower susceptibility to clinically relevant antibiotics, particularly third/fourth generation cephalosporins and fluoroquinolones. Carbapenem susceptibility remains relatively stable but should be monitored, particularly for carbapenemase-producing *E. coli* mediated by 0XA-48.

Neisseria meningitidis

Results

In 2023, 107 laboratory-confirmed episodes of invasive meningococcal disease (IMD) were reported through the GERMS-SA surveillance programme, a 53% increase in episodes from 2022 (n=70). Forty-two viable isolates were sent to the NICD for further characterisation; 58 episodes were diagnosed through molecular methods only, and seven episodes were detected through an audit of the NHLS laboratory information system (Table 2). Incidence of IMD increased from 0.12 per 100 000 persons in 2022 to 0.18 per 100 000 in 2023 and was almost at levels experienced in 2019 (pre-COVID-19 pandemic) (Figure 8). The Western Cape Province continued to experience a higher incidence of IMD than other provinces (0.61 per 100 000) (Table 8). IMD occurred in persons of all age categories with the highest peak in children <1 year of age (1.6 episodes per 100 000) and then decreasing with increasing age-categories (Figure 9). No clusters were reported in 2023, and most episodes occurred between June and September (Figure 10), with more males (64/107, 60%) affected than females. Sixty-eight per cent (73/107) of IMD episodes were confirmed from cerebrospinal fluid and the rest from blood specimens (Table 9). Where serogrouping was done (83/107, 76%), 53% (44/83) were serogroup B, 18% (15/83) W, 13% (11/83) Y, 12% (10/83) C, and 3 were non-groupable (Table 10). Serogroup B was dominant in almost all age categories, whilst serogroup C occurred only in persons <5 years and 45–64 years, and serogroup Y occurred mostly in persons >10 yet <45 years of age (Figure 11). Of viable isolates, 50% (21/42) were susceptible to penicillin, 38% (16/42) had intermediate susceptibility (penicillin minimum inhibitory concentrations (MIC) between 0.094 and 0.25µg/ml), and 12% (5/42) were penicillin resistant (MIC 0.38µg/ml). Three of the five penicillin-resistant isolates were serogroup W and occurred in three different provinces. All viable isolates were susceptible to third-generation cephalosporins, ciprofloxacin, rifampicin, and nalidixic acid.

In 2023, 75% (18/24) of episodes at enhanced surveillance sites had clinical data collected (Table 4). Median age was 17 years (interquartile range (IQR) 2-35 years) and patients stayed a median of eight days (IQR 7-13 days) in hospital. Eighty-nine per cent (16/18) were admitted with meningitis, and the in-hospital case-fatality was 11% (2/18). Twenty-eight per cent (5/18) were persons living with HIV (Table 4). Four persons, all less than 15 years of age, were discharged with sequelae (4/16, 25%). Two children had two sequelae each (neurological fallout with either hydrocephalus or new onset seizures), of the other two, one had new onset seizures and the other neurological fallout.

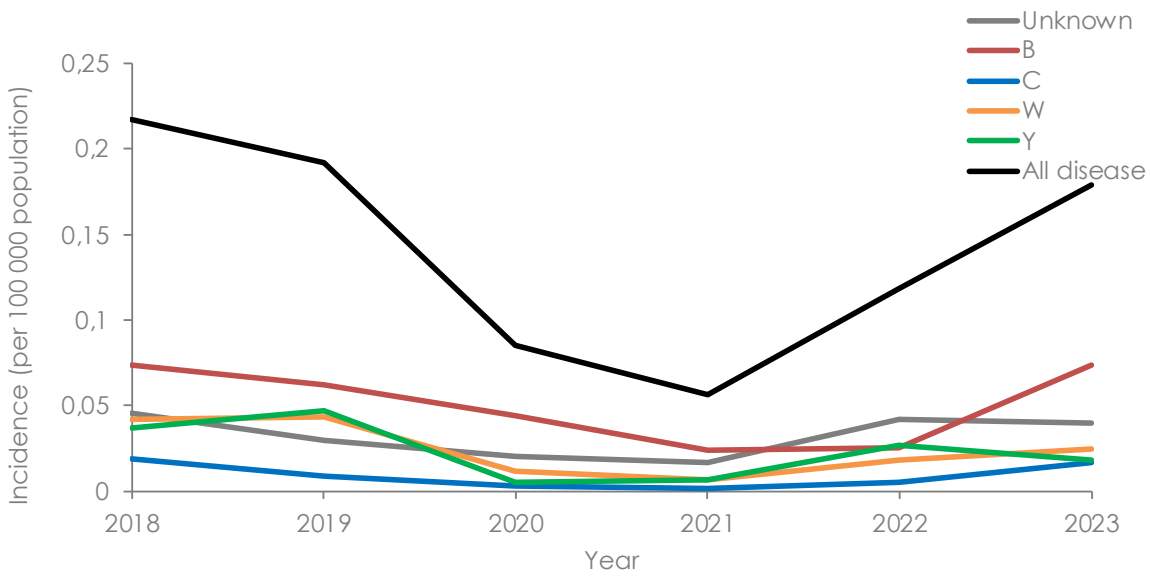

Figure 8. Incidence of invasive meningococcal disease by serogroup, South Africa, 2018-2023 (N=495)

Table 8. Number of cases and incidence of meningococcal disease reported to GERMS-SA by province, South Africa, 2019-2023, N=371 (including audit cases)

Site of specimen	2019		2020		2021		2022		2023	
	n	Incidence	n	Incidence	n	Incidence	n	Incidence	n	Incidence
Eastern Cape	12	0.18	6	0.09	5	0.07	5	0.07	12	0.19
Free State	3	0.10	0	0.00	0	0.00	3	0.10	4	0.14
Gauteng	37	0.24	10	0.06	8	0.05	23	0.14	32	0.20
KwaZulu-Natal	13	0.12	4	0.03	3	0.03	6	0.05	9	0.08
Limpopo	2	0.03	1	0.02	0	0.00	3	0.05	2	0.03
Mpumalanga	1	0.02	1	0.02	1	0.02	2	0.04	0	0.00
Northern Cape	1	0.08	0	0.00	0	0.00	1	0.08	3	0.27
North West	4	0.10	1	0.02	1	0.02	2	0.05	2	0.05
Western Cape	38	0.56	27	0.39	15	0.20	25	0.35	43	0.61
South Africa	**111**	**0.19**	**50**	**0.08**	**33**	**0.05**	**70**	**0.12**	**107**	**0.18**

*Incidence were calculated based on population denominators provided by the Thembisa Model, and are expressed as cases per 100 000 population.

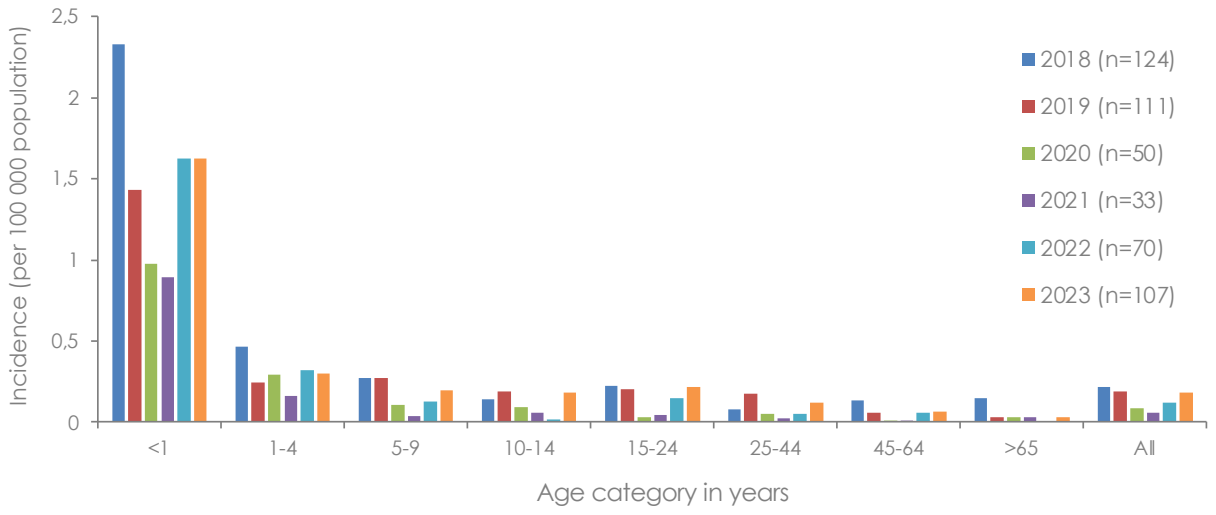

Figure 9. Incidence of invasive meningococcal disease by age-category, South Africa, 2018-2023 (N=495)

(Age unknown for 3 episodes: 2018 n=1 and 2023 n=2)

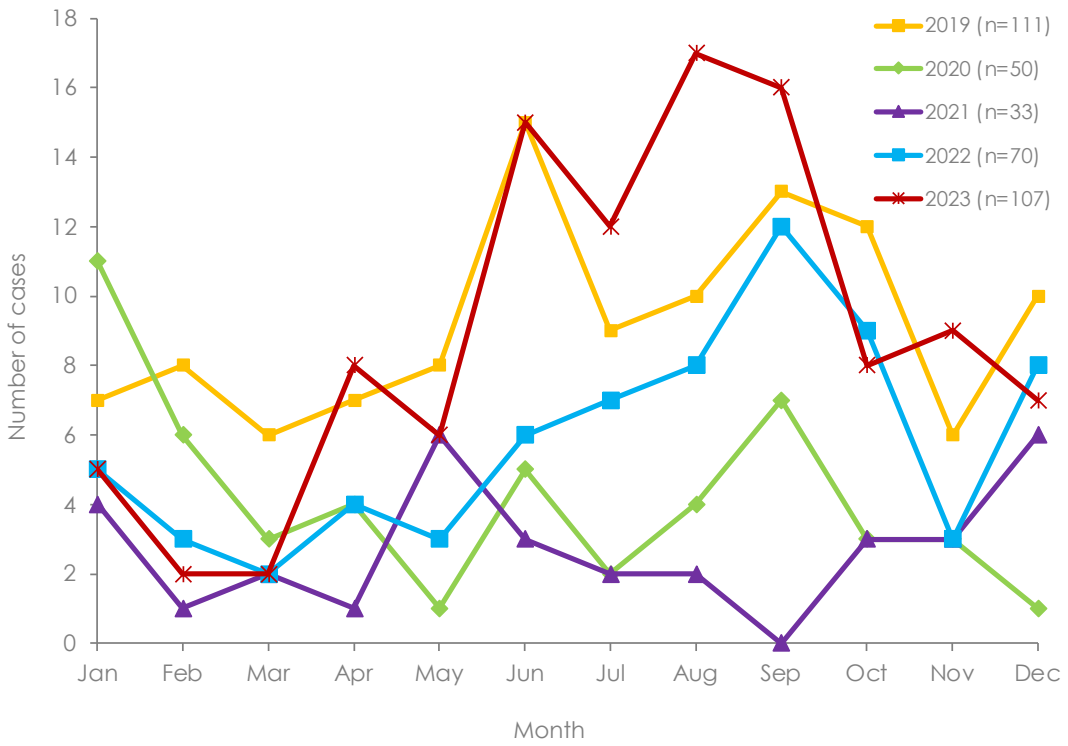

Figure 10. Number of laboratory-confirmed, invasive, meningococcal cases, reported to GERMS-SA, by month and year, South Africa, 2019-2023 (N=371)

Table 9. Number and percentage of cases of meningococcal disease reported to GERMS-SA by specimen type, South Africa, 2019-2023, N=371

Site of specimen	2019		2020		2021		2022		2023	
	n	%	n	%	n	%	n	%	n	%
Cerebrospinal fluid	70	63	24	48	20	61	45	64	73	68
Blood	41	37	26	52	13	39	25	36	34	32
Other	0	0	0	0	0	0	0	0	0	0
Total	**111**		**50**		**33**		**70**		**107**	

Table 10. Number of cases of invasive meningococcal disease reported to GERMS-SA by serogroup and province, South Africa, 2023, N=107*

Province	Serogroup							
	Serogroup not available	A	B	C	W	Y	NG	Total
Eastern Cape	2	0	6	1	2	1	0	12
Free State	0	0	1	2	1	0	0	4
Gauteng	11	0	12	3	3	3	0	32
KwaZulu-Natal	1	0	5	0	1	0	2	9
Limpopo	0	0	0	0	2	0	0	2
Mpumalanga	0	0	0	0	0	0	0	0
Northern Cape	2	0	0	0	0	1	0	3
North West	0	0	1	0	1	0	0	2
Western Cape	8	0	19	4	5	6	1	43
South Africa	**24**	**0**	**44**	**10**	**15**	**11**	**3**	**107**

*83 (76%) with viable isolates or specimens available for serogrouping/genogrouping; NG: Non-groupable unencapsulated meningococcal isolates

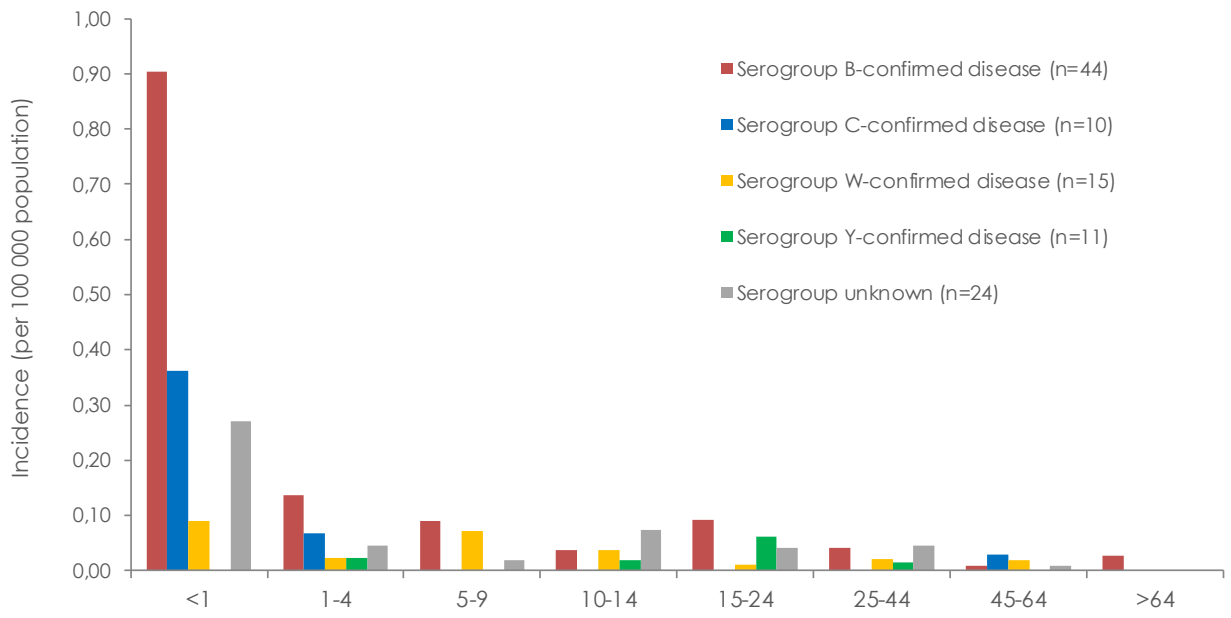

Figure 11: Age-specific incidence* for laboratory-confirmed, invasive, meningococcal cases, by serogroup B, C, W and Y, South Africa, 2023, N=107 (**specimens or viable isolates unavailable for serogrouping n=24, non-groupable disease n=3).**

Discussion

IMD incidence in 2023 has continued to increase since 2021 and has almost returned to that of 2019 (pre-COVID-19 pandemic, where after many respiratory transmitted infections decreased as a result of various COVID-19 containment measures). Serogroup B continued to dominate, particularly among infants, where IMD incidence was highest. Half of the isolates tested were penicillin non-susceptible, and this trend needs to be monitored. However, all were fully susceptible to antibiotics used for empiric antibiotic treatment of meningitis and for chemoprophylaxis in close contacts of cases.

In 2023, one in ten persons with IMD died, and a quarter of those who survived were discharged with sequelae. Although infants are at the highest risk of IMD, the median age of patients presenting to ESS has increased, indicating an increase in disease in young adults. Clinicians are urged to consider the diagnosis in any persons presenting with fever and/or headache with rapid clinical deterioration. On suspicion of IMD, immediate initiation of third-generation cephalosporin or high-dose intravenous penicillin is still recommended.

Haemophilus influenzae

Results

In 2023, 301 episodes of invasive *Haemophilus influenzae* (HI) disease were identified through the GERMS-SA surveillance programme. Of these, 148 viable isolates were received by the NICD for further characterisation, 53 episodes were diagnosed through molecular methods only, and 100 (33%) episodes were detected through an audit of the NHLS laboratory information system (Table 2). Eight persons were co-infected with *Streptococcus pneumoniae*: two cultured from cerebrospinal fluid, five from blood specimens, and one from pleural fluid. In South Africa, incidence of invasive HI was 0.50 per 100 000 population (similar to 2022, 0.58 per 100 000). Incidence was highest in the Western Cape Province (1.66 per 100 000 population) and lowest in the North West Province (0.10 per 100 000) (Table 11, Figure 12). Infants had the highest incidence of HI disease (7.59 episodes per 100 000 population), dropping lowest in children 10–14 years (0.09 per 100 000), before gradually increasing with increasing age (Figure 13). Sixty per cent (180/301) of episodes had a known serotype (Table 11). The majority of invasive HI disease was caused by non-typeable (HNT, 103/180), followed by type B (Hib, 44/180). Serotypes A, C, E, and F were also detected in 11, 2, 6, and 14 episodes, respectively. Incidence of HNT disease was highest in all age groups, besides children 1–4 years, where Hib was more common (Figures 14 and 15). For all HI serotypes, invasive HI was detected most commonly from blood specimens (64%, 194/301) (Table 12). Twenty per cent (30/148) of HI cases were non-susceptible to ampicillin (MICs >1mg/L); this included 32% (12/38) of Hib, 16% (13/80) of HNT, and 17% (5/30) of serotype A and C-F episodes.

At enhanced surveillance sites, 89% (126/142) of HI episodes had clinical information collected (Table 4). Median admission time was 7 days (interquartile range (IQR) 1-16 days). Thirty per cent (38/126) of patients died in-hospital, with a median time to death of one day (IQR 0-6 days) from specimen collection date. Deaths occurred with all serotypes and in all age categories; however, case fatality was highest at the extremes of age (33% (16/49) among children <5 years of age and 89% (8/9) among those >64 years). Of those tested for HIV, 26% (30/115) were living with HIV. (Table 4) Other conditions predisposing to HI disease were reported in 64% of (81/126) patients; the most common conditions included prematurity (born <37 weeks gestation) in infants (69%, 18/26), ever having tuberculosis (10%, 13/126), malignancy (7%, 9/126), chronic lung disease (6%, 8/126), and chronic renal disease (3%, 4/126).

Of patients from ESS with meningitis, 45% (9/20) died and 18% (2/11) who were discharged from hospital suffered long-term sequelae. Both patients who survived suffered new-onset seizures, and in addition, one of these developed hydrocephalus, and the other patient had limb weakness.

Among 9 children aged <15 years admitted to ESS with Hib infection, Hib conjugate vaccination history was available for seven. Of the five babies aged <8 weeks, three had not received any Hib vaccine, and two had received a dose less than a week before becoming ill. The other two children had each received three doses of the Hib vaccine but were not yet eligible for the 18-month booster dose. All seven were HIV-uninfected, and six reported underlying risk factors for HI disease, including three who were born prematurely (<37 weeks gestation), two who had been diagnosed with tuberculosis, and one with an underlying head injury.

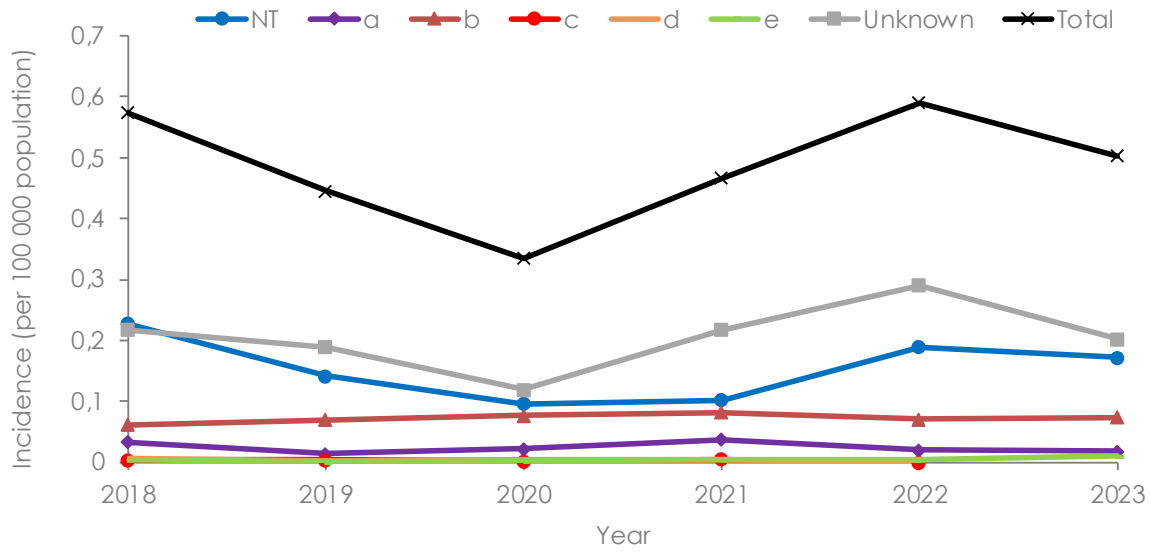

Figure 12. Incidence of invasive *Haemophilus influenzae* disease by serogroup, South Africa, 2018-2023 (N=1704)

Table 11. Number of cases and incidence of invasive *Haemophilus influenzae* disease reported to GERMS-SA by serotype and province, South Africa, 2023, N=301*

Province	Serotype										
	Serotype not available	A	B	C	D	E	F	Total	Non-typeable	Total	Incidence per 100 000 population†
Eastern Cape	6	2	5	0	0	1	1	12	7	22	0.34
Free State	4	0	0	0	0	0	0	4	3	7	0.24
Gauteng	38	2	10	1	0	1	4	32	33	89	0.55
KwaZulu-Natal	19	2	5	0	0	2	2	9	8	38	0.33
Limpopo	7	0	1	0	0	0	0	2	3	11	0.18
Mpumalanga	4	0	0	0	0	0	0	0	2	6	0.12
Northern Cape	3	0	1	0	0	0	0	3	2	6	0.54
North West	4	0	0	0	0	0	0	2	0	4	0.10
Western Cape	36	5	22	1	0	2	7	43	45	118	1.66
South Africa	**121**	**11**	**44**	**2**	**0**	**6**	**14**	**107**	**103**	**301**	**0.50**

*180 (60%) with specimens or viable isolates available for serotyping.
†Incidence were calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population.

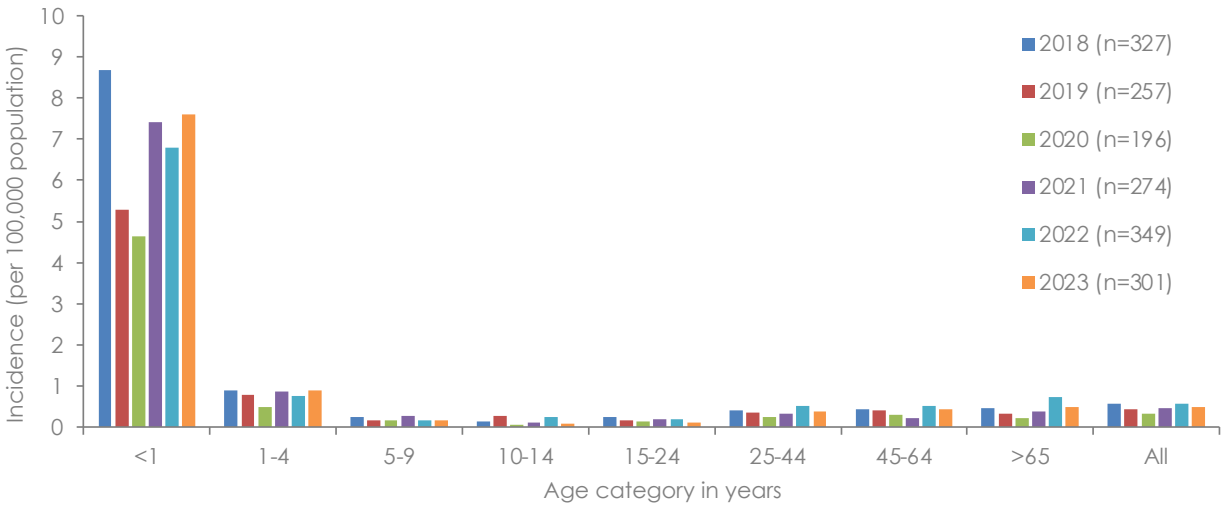

Figure 13. Incidence of invasive *Haemophilus influenzae* disease by age-category, South Africa, 2018-2023 (N=1704)

(Age unknown for 54 episodes: 2018 n=9, 2019 n=2, 2020 n=8, 2021 n=9, 2022 n=14 and 2023 n=12)

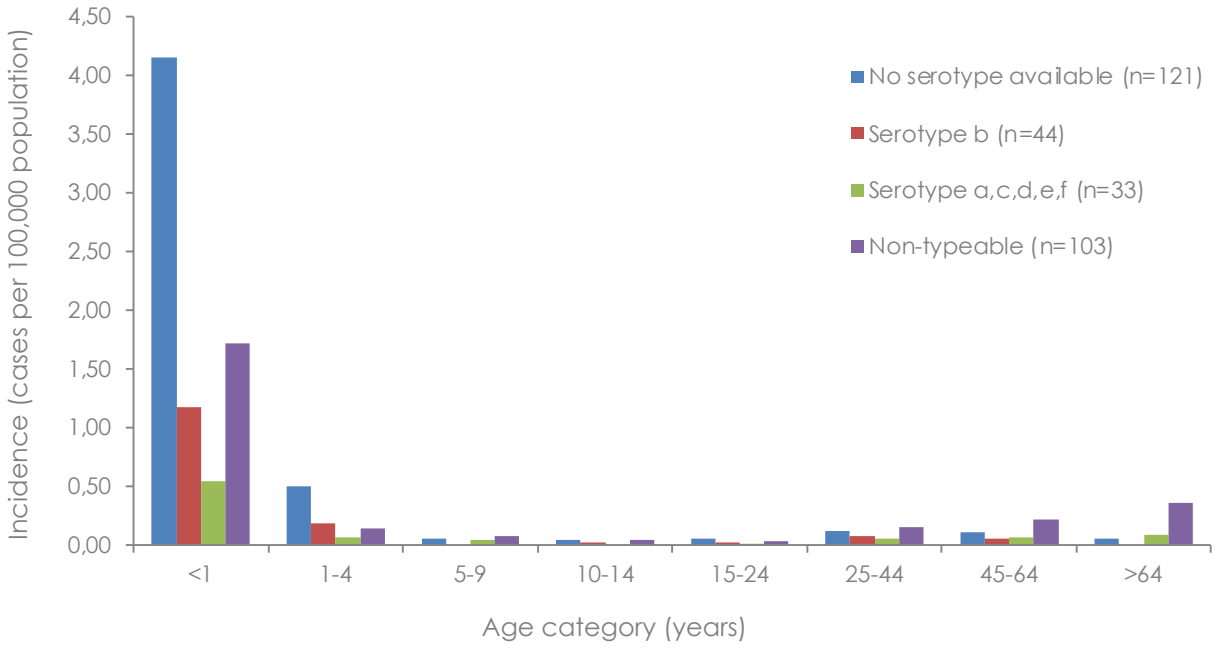

Figure 14. Age-specific incidence* for laboratory-confirmed, invasive *Haemophilus influenzae* disease, reported to GERMS-SA, by serotype, South Africa, 2023, N=301 (age unknown, n=12; isolates unavailable for serotyping, n=121).

*Incidence rates were calculated based on population denominators provided by Thembisa model, and are expressed as cases per 100 000 population.

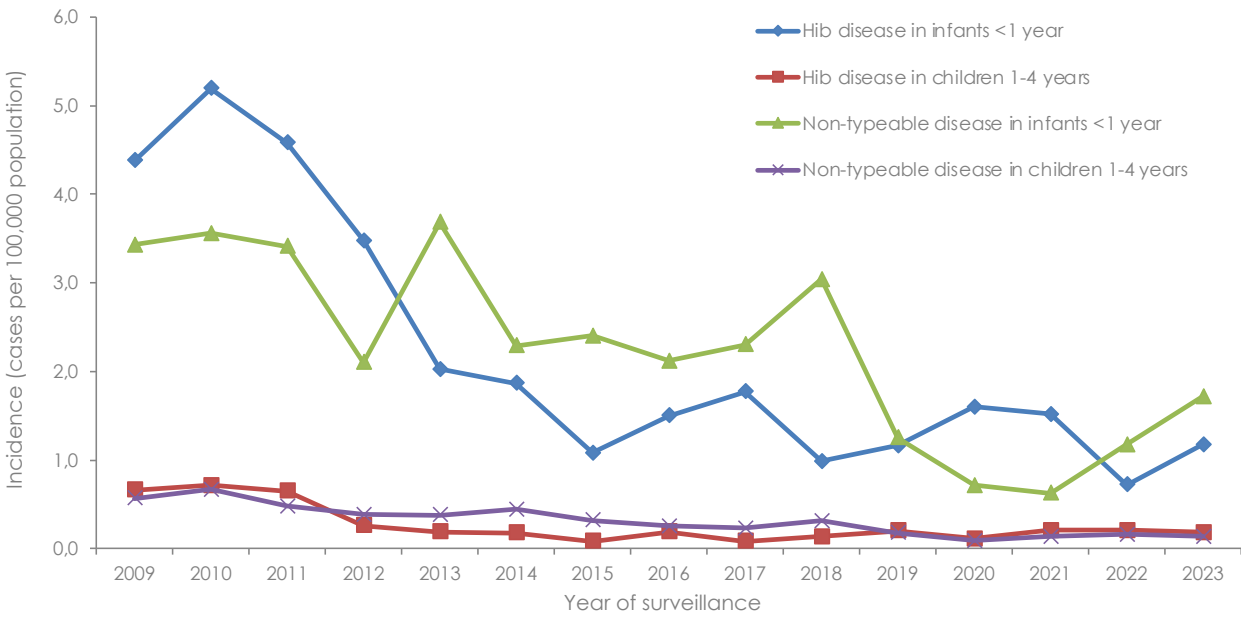

Figure 15. Incidence* of laboratory-confirmed, *Haemophilus influenzae* serotype b and non-typeable disease, reported to GERMS-SA, in children <5 years old, South Africa, 2009-2023.

*Incidence rates were calculated based on population denominators provided by Thembisa model, and are expressed as cases per 100 000 population.

Table 12. Number and percentage of cases of invasive *Haemophilus influenzae* disease reported to GERMS-SA by specimen type, South Africa, 2023, N=301

Site of specimen	No serotype available		Serotype b		Serotypes a, c, d, e, f		Non-typeable	
	n	%	n	%	n	%	n	%
Cerebrospinal fluid	27	22	17	39	5	15	5	5
Blood	62	51	26	59	25	76	81	79
Other	32	26	1	2	3	9	17	16
Total	**121**		**44**		**33**		**103**	

Discussion

HI incidence has remained similar to that of 2022, with HNT disease dominating in most age categories. The Western Cape Province continues to report a higher incidence of HI disease than all other provinces, partly due to higher capacity for processing invasive specimens, which may possibly lead to higher specimen-taking practices amongst clinicians. We also noted an increase in ampicillin non-susceptible isolates from all serotypes, which will need to be monitored closely in 2024. In-hospital case fatality following HI infection was highest at the extremes of age, and the extremely high case fatality in the elderly is concerning. The children with Hib disease who had a vaccination history available were all appropriately vaccinated for their age.

Streptococcus pneumoniae

Results

In 2023, 1807 episodes of laboratory-confirmed invasive pneumococcal disease (IPD) were reported to the GERMS-SA surveillance programme. This included 1141 viable isolates (63%) sent to the NICD for further characterisation, 211 (12%) episodes identified through molecular testing, and 455 (25%) detected through the NHLS laboratory information system (Table 2). Incidence of IPD in South Africa for 2023 was 3.02 per 100 000 population, similar to that of 2022 (3.14 per 100 000), yet remaining lower than 2019 (4.07 per 100 000) prior to the COVID-19 pandemic. Incidence in the Western Cape Province (8.76 per 100 000) was almost 3 times higher than the national incidence, whilst in other provinces IPD incidence ranged between 0.83–3.65 per 100 000 (Table 13). Incidence was highest in infants (14.90 per 100 000), with a second peak in adults 45–64 years (4.43 per 100 000) (Figure 16). Where gender was known, 52% (882/1703) of IPD episodes occurred in males. Most episodes were diagnosed from blood (1149/1807, 64%) and cerebrospinal fluid (514/1807, 28%) specimens (Table 14). Penicillin non-susceptibility (minimum inhibitory concentration (MIC) >0.06µg/ml) was demonstrated in 34% (381/1128) of cultured isolates, and children 1–4 years had the highest proportion of non-susceptible isolates (32/55, 58%) (Table 15 and Figure 17). Ceftriaxone non-susceptibility (MIC >0.5µg/ml) was detected amongst 9% (96/1128) of isolates. The top three serotypes (in order) occurring in children <5 years included serotypes 8, 3, and 19F, while in persons >5 years, serotypes 3, 8, and 4 dominated (Figures 18a and 18b). Overall, potential coverage of serotypes in the 13-valent pneumococcal conjugate vaccine (PCV13) was 32% (425/1332) and 59% (781/1332) for the 23-valent polysaccharide vaccine (Figure 19 and Table 16).

At enhanced surveillance sites, 90% (648/717) of persons with IPD had clinical data collected. Patients were admitted for a median of 7 days (interquartile range [IQR] 1–13 days). In-hospital case fatality rate was 33% (211/646), increasing from 21% (10/48) in infants to 55% (29/53) in persons >64 years. Most deaths occurred within one day of specimen collection (IQR 0–5 days).

Of those tested for HIV, 53% (334/629) were HIV-infected. Thirty-four per cent (13/38) of infants with maternal HIV-status available were HIV-exposed (one baby was HIV-infected, 11 were HIV-uninfected, and HIV-status was unknown for one baby). Fifty-nine per cent (382/647) of patients had a condition/risk factor (excluding HIV infection) predisposing them to IPD. The top five factors included: ever having tuberculosis (16%, 103/647), diabetes (7%, 45/647), chronic lung disease (6%, 40/647), chronic renal disease, or chronic heart disease (4%, 28/647, each). Among infants, 33% (6/18) were premature, and among persons >15 years, 37% (123/331) were current smokers, and 16% (54/331) reported excessive alcohol use.

Of 135 persons at ESS with pneumococcus detected in CSF, 41% (55/135) died during their hospitalisation, and 23% (18/80) who survived to discharge suffered at least one sequela upon discharge (two persons had >1 sequelae). Sequelae included new-onset seizures (nine), limb weakness/paralysis (seven), hearing loss (three), and vision loss (one).

Of 109 children <10 years of age with IPD at ESS, 74% (81/109) had non-PCV13 serotype disease, and 26% (28/109) had IPD caused by serotypes present in PCV13, including nine serotypes 19F, seven serotypes 19A, six serotypes 3, and one each for serotypes 4, 6A, 7F, 9V, 14, and 23F. Vaccination history was available for 19 of 28 children with PCV13 serotype disease: two children (aged five and nine months) had never received any PCV13 doses, four were too young to have received the 6-week dose, four had received appropriate doses for age, one had missed their booster dose, and eight had received all three doses. The serotypes responsible for disease in children who had been fully vaccinated included serotypes 19F (four children), 19A (three children) and 23F (one child), and 63% (5/8) had an underlying risk factor predisposing to IPD.

Table 13. Number of cases and incidence of invasive pneumococcal disease reported to GERMS-SA by province, South Africa, 2019-2023, N=8818 (including audit cases)

Site of specimen	2019		2020		2021		2022		2023	
	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*
Eastern Cape	274	4.23	136	2.10	201	3.10	224	3.46	236	3.65
Free State	83	2.90	62	2.16	70	2.43	62	2.16	62	2.16
Gauteng	774	5.08	377	2.42	466	2.98	515	3.25	540	3.35
KwaZulu-Natal	237	2.14	101	0.90	116	1.03	158	1.40	158	1.39
Limpopo	96	1.65	52	0.88	45	0.76	69	1.15	67	1.11
Mpumalanga	102	2.20	41	0.87	56	1.18	53	1.11	40	0.83
Northern Cape	89	8.02	26	2.33	25	2.23	27	2.42	26	2.32
North West	66	1.67	36	0.90	32	0.79	48	1.18	57	1.38
Western Cape	631	9.34	417	6.07	539	7.80	704	10.08	621	8.76
South Africa	**2352**	**4.07**	**1249**	**2.14**	**1550**	**2.64**	**1860**	**3.14**	**1807**	**3.02**

*Incidence was calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population.

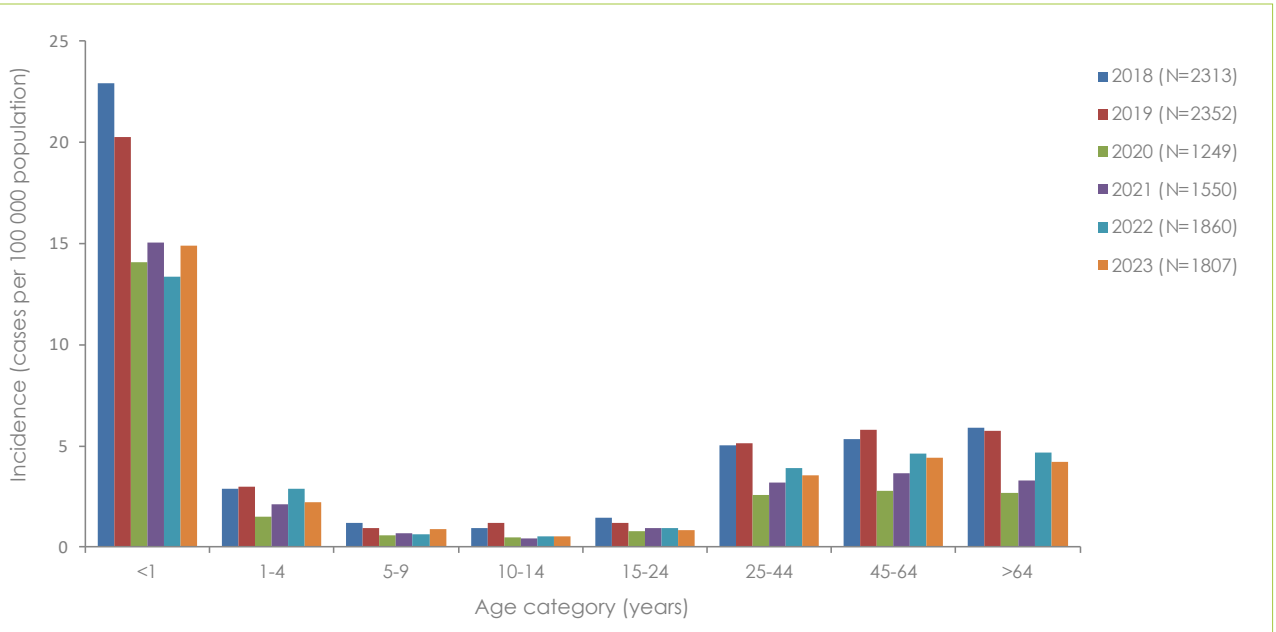

Figure 16. Age-specific incidence* for laboratory-confirmed, invasive pneumococcal disease, reported to GERMS-SA, South Africa, 2018-2023, N=11 131

*Incidence were calculated based on population denominators provided by Thembisa model, and are expressed as cases per 100 000 population.

Table 14. Number and percentage of cases of invasive pneumococcal disease reported to GERMS-SA by specimen type, South Africa, 2019-2023, N=8818

Site of specimen	2019		2020		2021		2022		2023	
	n	%	n	%	n	%	n	%	n	%
Cerebrospinal fluid	701	30	340	27	385	25	425	23	514	28
Blood	1484	63	813	65	1068	69	1312	71	1149	64
Other	167	7	96	8	97	6	123	7	144	8
Total	**2352**		**1249**		**1550**		**1860**		**1807**	

Table 15. Number and percentage of penicillin susceptible and non-susceptible isolates from invasive pneumococcal disease cases reported to GERMS-SA by province, South Africa, 2023, N=1807

Province	Isolate not available	Susceptible*		Resistant*	
	n	n	%	n	%
Eastern Cape	95	90	64	51	36
Free State	29	25	76	8	24
Gauteng	250	180	62	110	38
KwaZulu-Natal	93	41	63	24	37
Limpopo	24	29	67	14	33
Mpumalanga	19	14	67	7	33
Northern Cape	15	7	64	4	36
North West	40	13	76	4	24
Western Cape	114	348	69	159	31
South Africa	**679**	**747**	**66**	**381**	**34**

*2023 CLSI breakpoints for penicillin (oral penicillin V) were used: susceptible, ≤0.06mg/L; resistant, ≥0.12mg/L.

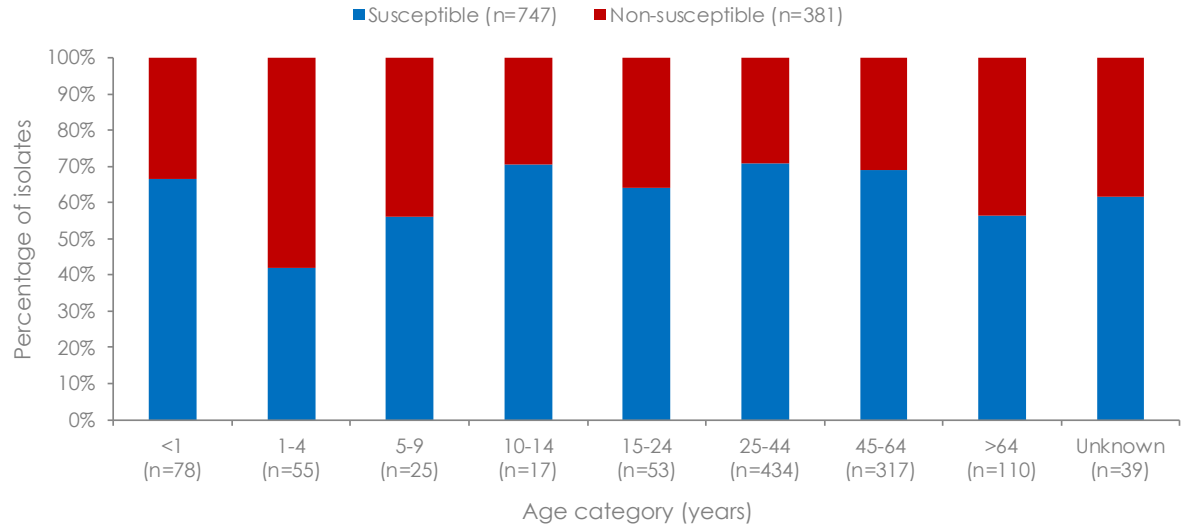

Figure 17. Number of laboratory-confirmed, invasive pneumococcal disease cases, reported to GERMS-SA, by age group and penicillin susceptibility, South Africa, 2023, N=1807 (n=1128 with viable isolates).

2023 CLSI breakpoints for penicillin (oral penicillin V) were used: susceptible,MIC ≤0.06mg/L; non-susceptible >0.06mg/L

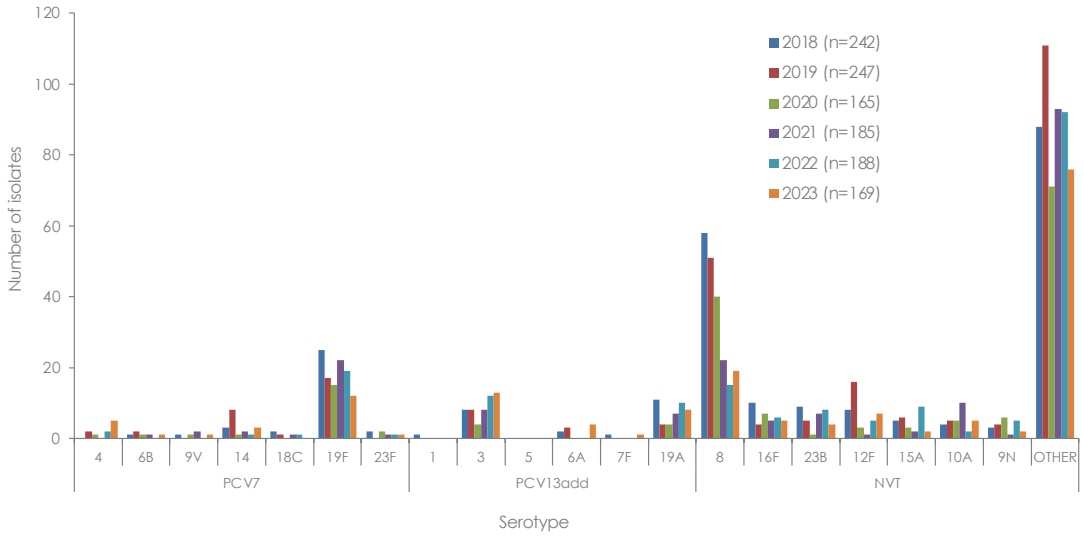

Figure 18a. Most common pneumoccocal serotypes causing laboratory-confirmed, invasive pneumococcal disease, reported to GERMS-SA, in children <5 years, South Africa, 2018-2023 (N=1771)

(2018: N=386, n=144 without serotype determined; 2019: N=361, n=114 without serotype; 2020: N=224, n=59 without serotype; 2021: N=263, n=78 without serotype; 2022: N=274, n=86 without serotype; 2023: N=263 , n=94 without serotype).

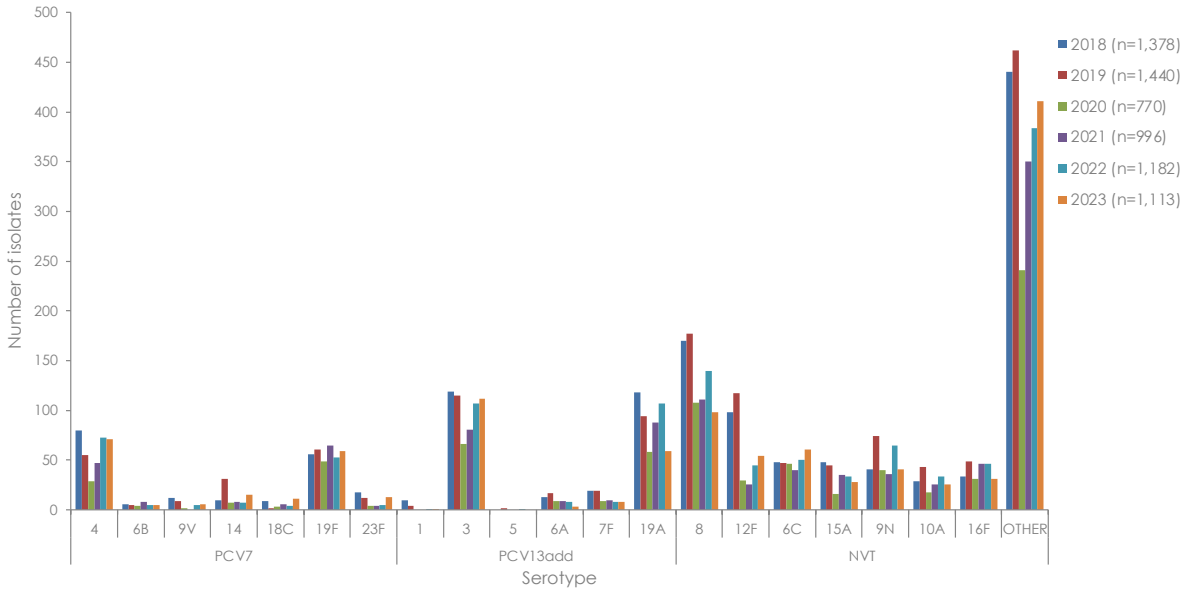

Figure 18b. Most common pneumoccocal serotypes causing laboratory-confirmed, invasive pneumococcal disease, reported to GERMS-SA, in adults and children >5 years, South Africa, 2018-2023 (N=9088).

Foot note: PCV7: seven-valent pneumococcal conjugate vaccine; PCV13add: additional serotypes in the thirteen-valent pneumococcal conjugate vaccine; NVT: non-PCV13 serotypes

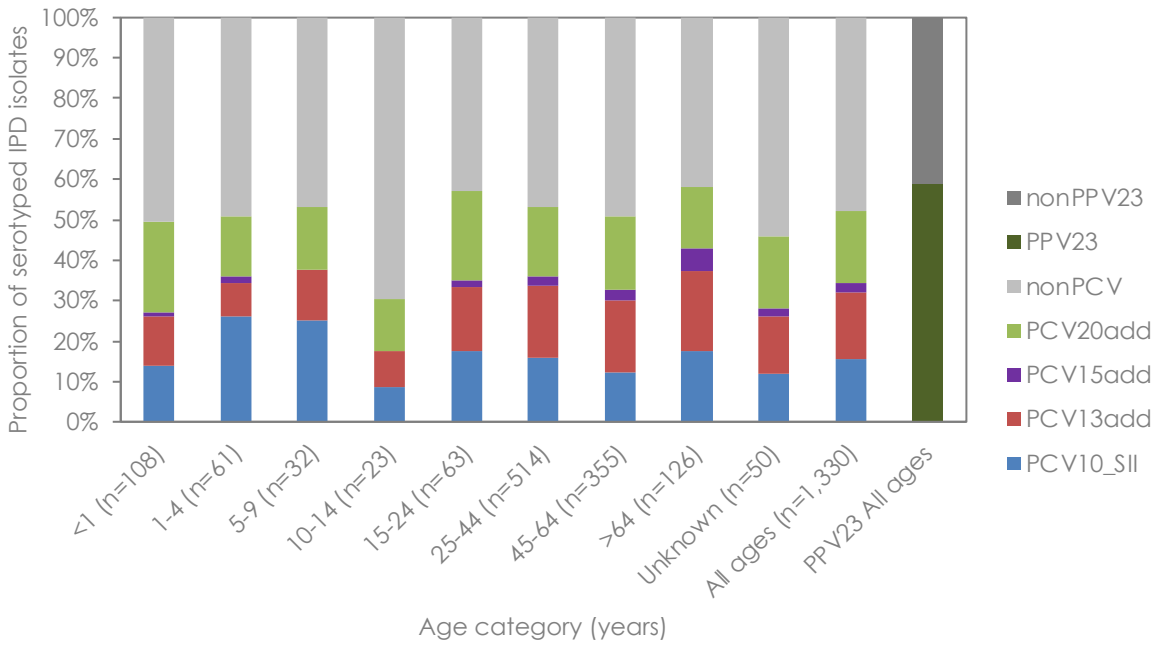

Figure 19. Potential pneumococcal serotype coverage of laboratory-confirmed, invasive pneumococcal disease, reported to GERMS-SA, by various pneumococcal conjugate vaccines and age categories, South Africa, 2023 (N=1807, n=477 episodes not serotyped)

Table 16. Number and percentage of invasive pneumococcal cases reported by the serotypes contained in the 10-, 13- 15- and 20-valent pneumococcal conjugate vaccine candidates and the 23-valent pneumococcal polysaccharide vaccine by age category, South Africa, 2023, N=1807 (n=1332 with isolates/specimens available for serotyping)

Age category (years)	Total isolates available for serotyping	SII 10-valent serotypes		GSK 10-valent serotypes		Pfizer 13-valent serotypes		Merck 15-valent serotypes		Pfizer 20-valent serotypes		23-valent sero-types	
		n	%	n	%	n	%	n	%	n	%	n	%
<1	108	15	14	14	13	28	26	29	27	53	49	55	51
1-4	61	16	26	10	16	21	34	22	36	31	51	35	57
5-9	32	8	25	9	28	12	38	12	38	17	53	18	56
10-14	23	2	9	2	9	4	17	4	17	7	30	10	43
15-24	63	11	17	10	16	21	33	22	35	36	57	41	65
25-44	514	82	16	99	19	172	33	185	36	273	53	310	60
45-64	355	44	12	50	14	107	30	116	33	180	51	206	58
>64	126	22	17	19	15	47	37	54	43	73	58	80	63
unk	50	6	12	9	18	13	26	14	28	23	46	26	52
	1332	**206**	**15**	**222**	**17**	**425**	**32**	**458**	**34**	**693**	**52**	**781**	**59**

Serotypes included in each of the pneumococcal vaccine categories:
Serum Institute India 10-valent serotypes: 1, 5, 6A, 6B, 7F, 9V, 14, 19A, 19F, 23F
GlaxoSmithKline 10-valent serotypes: 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F
Pfizer 13-valent serotypes: 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F, 3, 6A, 19A
*Merck 15-valent serotypes: 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F, 3, 6A, 19A, 22F, 33F
*Pfizer 20-valent serotypes: 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F, 3, 6A, 19A, 22F, 33F, 8, 10A, 11A, 12F,15B
23-valent serotypes: 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F, 3, 19A, 22F, 33F, 8, 10A, 11A, 12F,15B, 2, 9N, 17F, 20

* Merck PCV15 and Pfizer PCV20 are not yet licenced for use in South Africa

Discussion

In 2023, IPD incidence was still below that of 2019, pre-COVID-19 pandemic. The Western Cape Province continues to show a higher incidence of IPD than other provinces. Although infants have the highest incidence, a second peak in adults aged 45–64 years reflects the ageing HIV-infected population and the high rate of other comorbidities in South Africa. Antimicrobial susceptibility remains similar to previous years. In-hospital case-fatality remains high for all IPD, with most deaths occurring in the elderly and amongst those with meningitis. Almost a quarter of those who survived pneumococcal meningitis developed long-term sequelae. Serotypes 3 and 8 were the top disease-causing serotypes in both children and adults, with serotypes 19F, 19A, and 3 among the PCV13 serotypes causing the most disease in children. An increase in serotype 4 IPD amongst adults over the last three years has also been noted. In 2024, South Africa will change to a PCV10 formulation in the expanded programme for immunisation, which excludes serotypes 3, 4, and 18C from the current PCV13. Therefore, ongoing surveillance to monitor trends in serotype-specific IPD is extremely important.

Group A Streptococcus *(Streptococcus pyogenes)*

Results

In 2023, 919 episodes of invasive group A Streptococcus (group A strep) were reported through the GERMS-SA surveillance programme, of which 512 (56%) were sent to the reference laboratory for further characterisation, 13 (1%) were detected through molecular testing, and 394 (43%) were detected through audit of the NHLS laboratory information system (Table 2). The case definition for invasive group A strep infection included individuals with group A strep isolated from a normally sterile site specimen or isolates from non-sterile site specimens with an accompanying diagnosis of septic shock, necrotising fasciitis or necrotic tissue. Overall incidence was 1.54 episodes per 100 000 persons, similar to 2019 (1.68 per 100 000), pre-COVID-19 pandemic. The Western Cape Province reported the highest incidence of invasive group A strep (5.05 per 100 000), followed by the Gauteng (2.03 per 100 000) and Eastern Cape (1.16 per 100 000) Provinces (Table 17). Incidence was highest in infants (5.96 per 100 000), dropping to a low of 0.27 per 100 000 in 10-14 year-olds and then increasing with increasing age to another peak in persons >64 years (2.55 per 100 000 population) (Figure 20). Where sex was known, infections occurred more often in males (63%, 568/906) than females. At enhanced surveillance sites, 88% (422/481) of persons with invasive group A strep had clinical data collected (Table 4). Most specimens were taken within one day of hospital admission (median 1 day, interquartile range [IQR] 0–3 days from admission date), and persons spent a median of 8 days in hospital (IQR 3–17 days).

In-hospital mortality was 20% (85/418), with most deaths occurring on the day of admission (IQR 0–6 days). The most common conditions associated with invasive group A strep infections included having an infected wound (27%, 113/422), necrotising fasciitis (16%, 69/422), osteomyelitis (14%, 57/422), cellulitis (11%, 46/422), septic arthritis (10%, 42/422), and streptococcus toxic shock syndrome (3%, 11/422). Common risk factors for developing group A strep included having had a penetrating wound following trauma (16%, 67/422), surgery in the past two weeks (8%, 35/422), burns (8%, 35/422), or blunt trauma (6%, 26/422). Of those with known HIV status, 28% (110/396) were persons living with HIV. From all age categories, most episodes were diagnosed from blood cultures (65%, 600/919); however, persons aged >5 years had a more diverse range of specimen types than children <5 years (Figure 21, Table 18). All isolates tested (512/512) were susceptible to penicillin (MIC<0.06µg/ml), and 95% (488/512) were susceptible to erythromycin (MIC<0.25µg/ml) (Table 19).

At enhanced surveillance sites, 88% (422/481) of persons with invasive group A strep had clinical data collected (Table 4). Most specimens were taken within one day of hospital admission (median 1 day, interquartile range [IQR] 0–3 days from admission date), and persons spent a median of 8 days in hospital (IQR 3–17 days). In-hospital mortality was 20% (85/418), with most deaths occurring on the day of admission (IQR 0–6 days). The most common conditions associated with invasive group A strep infections included having an infected wound (27%, 113/422), necrotising fasciitis (16%, 69/422), osteomyelitis (14%, 57/422), cellulitis (11%, 46/422), septic arthritis (10%, 42/422), and streptococcus toxic shock syndrome (3%, 11/422). Common risk factors for developing group A strep included having had a penetrating wound following trauma (16%, 67/422), surgery in the past two weeks (8%, 35/422), burns (8%, 35/422), or blunt trauma (6%, 26/422). Of those with known HIV status, 28% (110/396) were persons living with HIV.

Table 17. Number of cases and incidence of invasive group A streptococcal disease reported to GERMS-SA by province, South Africa, 2019-2023, N=4,094 (including audit cases)

Province	2019		2020		2021		2022		2023	
	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*
Eastern Cape	143	2.21	71	1.10	151	2.33	120	1.85	75	1.16
Free State	22	0.77	11	0.38	21	0.73	35	1.22	26	0.90
Gauteng	200	1.31	95	0.61	175	1.12	262	1.65	327	2.03
KwaZulu-Natal	162	1.46	49	0.44	92	0.82	97	0.86	72	0.63
Limpopo	7	0.12	5	0.09	11	0.18	20	0.33	25	0.41
Mpumalanga	11	0.24	9	0.19	23	0.49	21	0.44	19	0.39
Northern Cape	7	0.63	7	0.63	3	0.27	2	0.18	6	0.54
North West	2	0.05	3	0.07	9	0.22	10	0.25	11	0.27
Western Cape	416	6.16	262	3.82	266	3.85	375	5.37	358	5.05
South Africa	**970**	**1.68**	**512**	**0.88**	**751**	**1.28**	**942**	**1.59**	**919**	**1.54**

*Incidence was calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population.

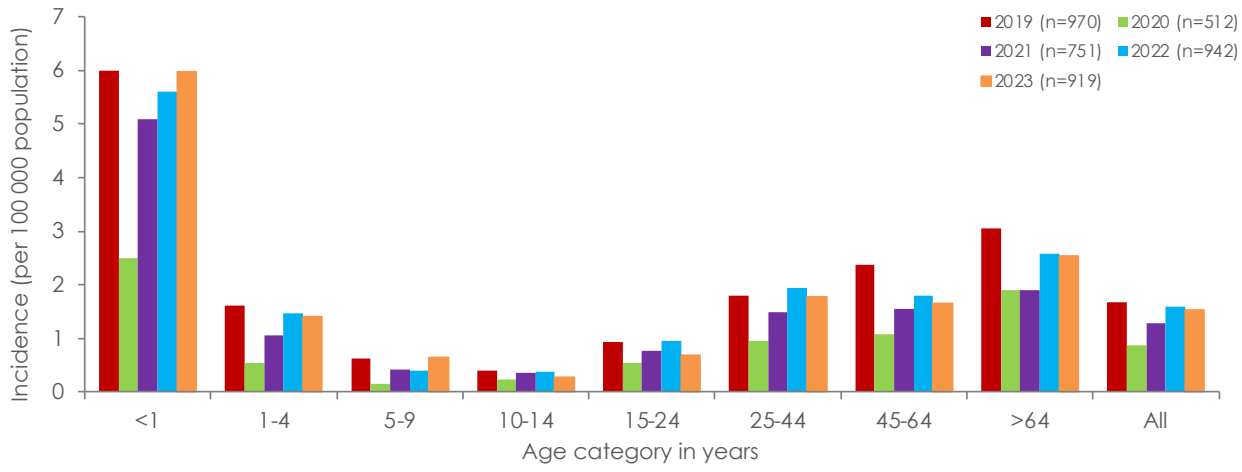

Figure 20. Incidence of invasive *Streptococcus pyogenes* (Group A Streptococcus) by age-category, South Africa, 2019-2023 (N=4094)

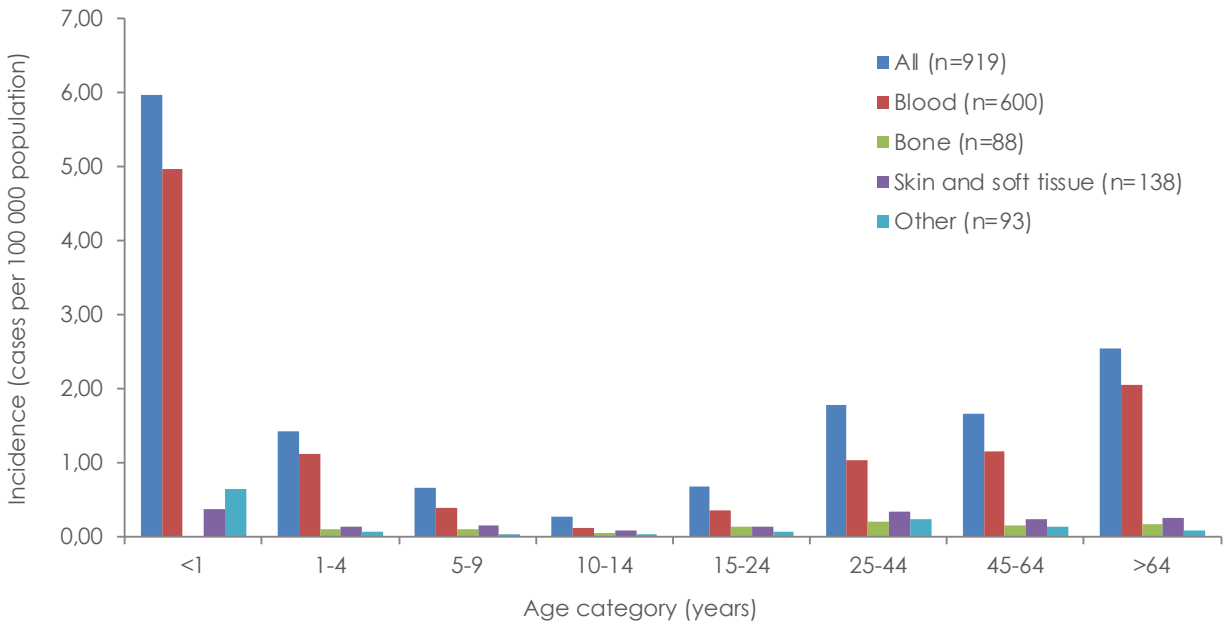

Figure 21. Age-specific incidence* for laboratory-confirmed, invasive group A streptococcal disease, reported to GERMS-SA, South Africa, 2023, n=919

*Incidence were calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population.

Table 18. Number and percentage of cases of invasive group A streptococcal disease reported to GERMS-SA by specimen type and age category, South Africa, 2023, N=919 (age unknown for n=60)

Site of specimen	Age <5 years		Age >5 years		Age unknown		All ages	
	n	%	n	%	n	%	n	%
Cerebrospinal fluid/brain	5	4	13	2	4	7	22	2
Blood	104	81	455	62	41	68	600	65
Skin and soft tissue*	10	8	123	17	5	8	138	15
Bone	4	3	83	11	1	2	88	10
Other**	5	4	57	8	9	15	71	8
Total	**128**		**731**		**60**		**919**	

*Skin and soft tissue includes skin swabs with an accompanying diagnosis of tissue necrosis, necrotising fasciitis or toxic shock syndrome. **Other includes invasive specimens from respiratory, genitourinary and gastrointestinal tracts.

Table 19. Number and percentage of penicillin and erythromycin susceptible and non-susceptible isolates from invasive group A streptococcal disease cases reported to GERMS-SA, South Africa, 2023, N=919 (isolate available for 512)

Site of specimen	Isolate not available	Susceptible*		Intermediate*		Resistant*	
	n	n	%	n	%	n	%
Penicillin	407	512	100	0	0	0	0
Erythromycin	407	488	95	1	0	23	5

*2023 CLSI breakpoints for penicillin (oral penicillin V) were used: susceptible, ≤0.06mg/L; intermediately resistant, 0.12-1mg/L; resistant, ≥2mg/L.

Discussion

For the majority of invasive group A strep infections, *Streptococcus pyogenes* likely originated from a breech to the skin through recent surgery or trauma. Infants and the elderly were most affected. All isolates from all invasive specimen types were highly susceptible to first-line antimicrobial agents.

Group B Streptococcus *(Streptococcus agalactiae)*

Results

In 2023, 1003 laboratory-confirmed episodes of invasive group B streptococcus (group B strep) were reported through the GERMS-SA network; 420 (42%) viable isolates were sent to the NICD reference laboratory for further characterisation, 17 (2%) were identified through molecular testing, and 566 (56%) were detected through the NHLS laboratory information system (Table 2).

Nationally, incidence for invasive group B strep fluctuated through the COVID-19 pandemic years but has now stabilised at rates similar to those of 2019 for almost all age categories. (Figures 22a and 22b). In 2023, infants had the highest incidence (46.34 per 100 000 population), dropping to a low of 0.02 per 100 000 in 5–9 year olds and then increasing with increasing age to another peak in those >64 years (1.11 per 100 000 population) (Table 20 and Figure 22a). Incidence per 1000 live births in 2023 was 0.28 for early-onset (<7 days of life) and 0.16 for late-onset (7-90 days) invasive group B strep disease (Figure 22b). Incidence of laboratory-confirmed episodes varies by province, with the Gauteng, Western Cape, and KwaZulu-Natal Provinces reporting the highest rates (Table 20). In infants, most cases were isolated from blood (436/513, 85%) or cerebrospinal fluid (68/513, 13%) (Table 21 and Figure 23a). However, in persons >1 year of age, blood (193/426, 45%) and genitourinary tract specimens (133/426, 31%) (particularly from adults of reproductive age) were most frequent (Table 21, Figure 23b). Where sex was known amongst infants, 45% (220/487) of episodes occurred among females; however, amongst persons >1 year, 71% (299/423) occurred amongst females. Of serotyped isolates, serotypes III (141/420, 34%), Ia (136/420, 32%), and V (43/420, 10%) were most common for all presentations (early-onset, late-onset, and disease in >1 year age group) and most provinces (Table 22, Figure 24a). Isolates from blood specimens were mostly serotype Ia (110/321, 34%) or serotype III (101/321, 31%), while CSF isolates were mainly serotype III (27/41, 66%). Of the genitourinary isolates typed, serotypes Ia, Ib, and III were most common (Figure 24b). Almost all (417/420, 99%) invasive group B strep isolates tested were sensitive to penicillin (MIC<0.12mg/L), 68% (286/420) to erythromycin (MIC<0.5mg/L), and only 6% (24/420) to tetracycline (MIC<2mg/L).

In 2023, 84% (408/488) of group B strep episodes at enhanced surveillance sites had clinical data collected (Table 4). The median length of hospital stay was 5 days (IQR 1-15 days). Overall, 16% (57/364) of patients with outcome data died, 18% (26/143) of those <1 and 14% (31/221) >1 year of age. Most deaths occurred on day 2 of admission (IQR 1–9 days).
Among 115 neonates with invasive group B strep, 17% (20/115) died. Underlying maternal risk factors for neonates developing invasive group B strep included 23% (26/115) with premature rupture of membranes prior to birth and 7% (8/115) with pre-eclampsia. Neonatal risk factors for developing invasive group B strep included 38% (44/115) born preterm (<37 weeks gestation), 10% (12/115) with very low birth weight (<1500g), and 14% (16/115) who required intubation.

Of a subset of 105 episodes of invasive group B strep with a diagnosis of intrauterine sepsis, one woman died. Eighty-nine per cent (93/105) of women with intrauterine sepsis were pregnant or postpartum at the time of the infection. Among these pregnant/postpartum women: 77% (72/93) of the pregnancies resulted in death of the neonate/foetus, 5% (5/93) had neonates with clinical group B strep infection, 1% (1/793) was still pregnant at discharge from hospital, and 16% (15/93) had neonates who appeared clinically well.

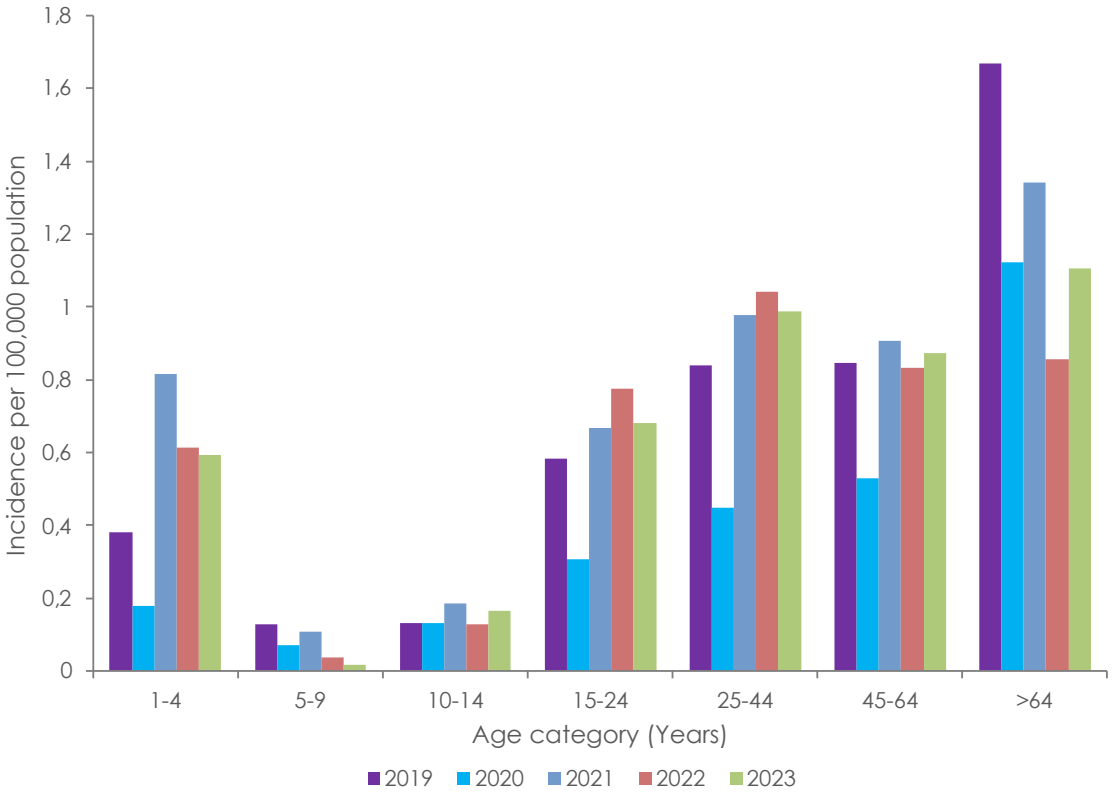

Figure 22a. Incidence of laboratory-confirmed invasive Group B Streptococcus by age category (>12 Months) and year reported to GERMS-SA, South Africa, 2019-2023 (N=5078, n=265 with unknown age and n=3103 <12 months)

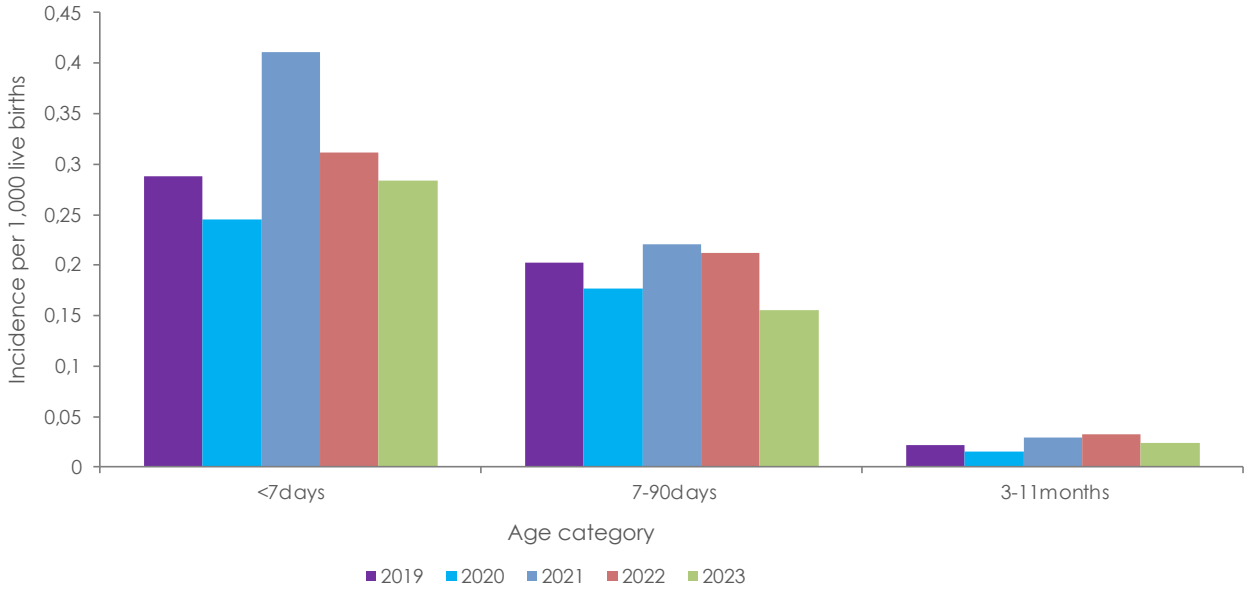

Figure 22b. Incidence of invasive Group B Streptococcus per 1000 live births by age category (<12 months) and year reported to GERMS-SA, South Africa, 2019-2022 (N=2417)

Table 20. Number of cases and incidence of invasive group B streptococcal disease reported to GERMS-SA by province and age category*, South Africa, 2023, N=1003 (age unknown for n=64)

Province	Early onset (<7 days)		Late onset (7-90 days)		Age category >1 year		All ages	
	n	Incidence (per 1 000 live births*)	n	Incidence (per 1 000 live births*)	n	Incidence (per 100 000 population)	n	Incidence (per 100 000 population)
Eastern Cape	11	0.09	7	0.06	32	0.50	54	0.84
Free State	15	0.28	6	0.11	16	0.57	39	1.36
Gauteng	145	0.53	72	0.26	205	1.29	480	2.98
KwaZulu-Natal	73	0.33	27	0.12	71	0.64	181	1.59
Limpopo	11	0.08	8	0.06	7	0.12	29	0.48
Mpumalanga	17	0.17	5	0.05	12	0.25	36	0.74
Northern Cape	1	0.04	1	0.04	3	0.27	5	0.45
North West	5	0.07	4	0.06	12	0.30	24	0.58
Western Cape	36	0.29	42	0.34	68	0.98	155	2.19
South Africa	**314**	**0.28**	**172**	**0.16**	**426**	**0.73**	**1,003**	**1.67**

*N=27 episodes in infants aged >90 days and less than one year excluded from above.
Denominators included mid-year population estimates from Thembisa Model.

Table 21. Number and percentage of cases of invasive group B streptococcal disease reported to GERMS-SA by specimen type and age category*, South Africa, 2023, N=1003

Site of specimen	Age <1 year		Age >1 years	
	n	%	n	%
Cerebrospinal fluid/brain	68	13	16	4
Blood	436	85	193	45
Skin and soft tissue	3	1	45	11
Genitourinary**	4	1	133	31
Other***	2	0	39	9
Total	**513**		**426**	

*Age unknown for n=64. Genitourinary specimens include uterine tissue, products of conception and placental tissue **Other includes invasive specimens from bone, respiratory and gastrointestinal tracts.

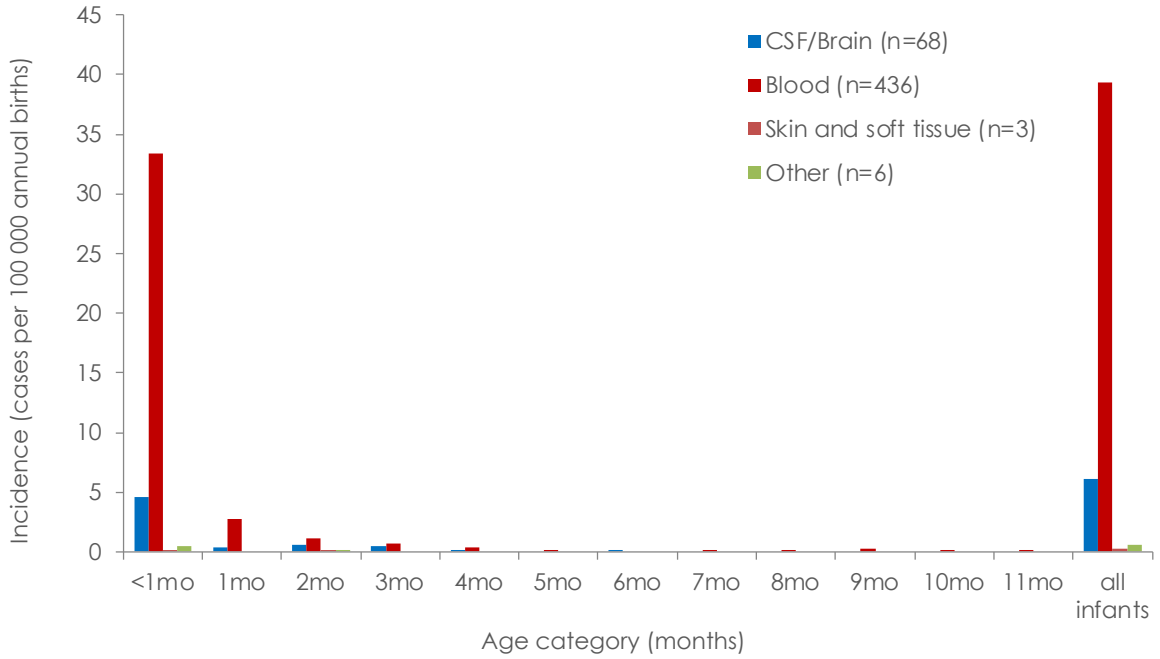

Figure 23a. Age-specific incidence* for laboratory-confirmed, invasive group B streptococcal disease in children <1 year of age, reported to GERMS-SA, South Africa, 2023, N=513

*Incidence were calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population.

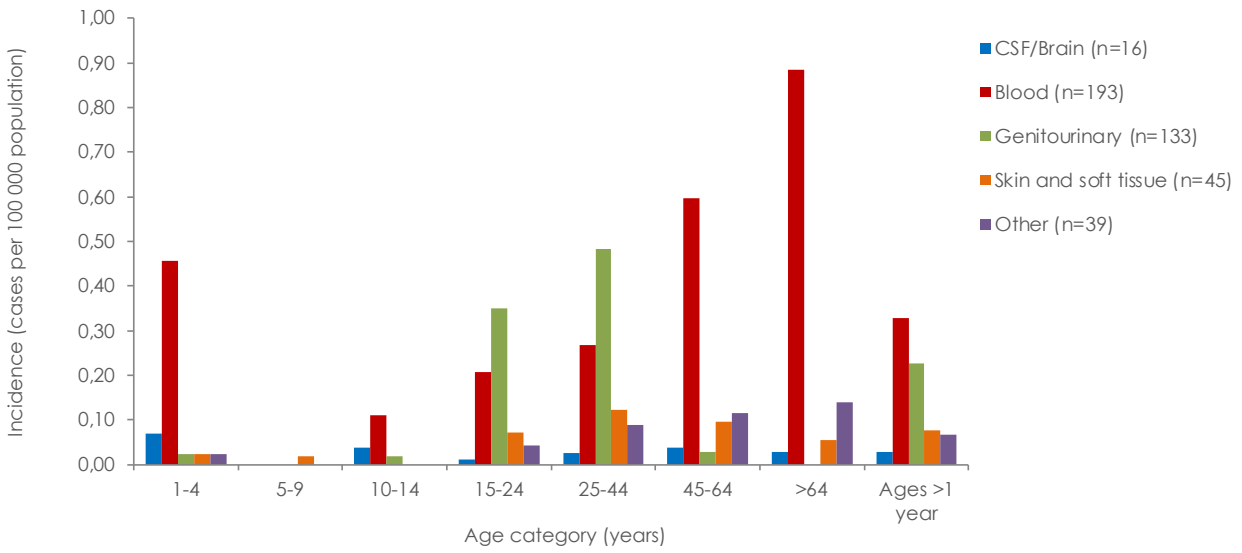

Figure 23b: Age-specific incidence* for laboratory-confirmed, invasive group B streptococcal disease in persons >1 year of age, reported to GERMS-SA, South Africa, 2023, N=426

*Incidence were calculated based on population denominators provided by Thembisa Model, and are expressed as cases per 100 000 population. N=513 episodes in children<1 year and n=64 episodes with age unknown)

Table 22. Serotype distribution of invasive group B streptococcal disease reported to GERMS-SA by province, South Africa, 2023, N=1003

Province	Total	Isolates available for sero-typing	Ia		Ib		II		III		IV		V		VIII		IX	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Eastern Cape	54	33	8	24	3	9	5	15	10	30	1	3	5	15	0	0	0	0
Free State	39	18	4	22	1	6	1	6	9	50	1	6	2	11	0	0	0	0
Gauteng	480	187	64	34	19	10	5	3	67	36	6	3	19	10	2	1	2	1
KwaZulu-Natal	181	45	17	38	5	11	10	22	7	16	1	2	5	11	0	0	0	0
Limpopo	29	11	1	9	1	9	1	9	5	45	1	9	1	9	0	0	1	9
Mpumalanga	36	12	3	25	1	8	4	33	4	33	0	0	0	0	0	0	0	0
Northern Cape	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North West	24	2	0	0	0	0	0	0	1	50	0	0	1	50	0	0	0	0
Western Cape	155	112	39	35	6	5	13	12	38	34	2	2	10	9	0	0	0	0
South Africa	**1,003**	**420**	**136**	**33**	**36**	**9**	**39**	**9**	**141**	**34**	**12**	**3**	**43**	**10**	**2**	**1**	**3**	**1**

Of 1003 episodes, 420 had viable isolates and were serotyped, seven isolates were non-typeable (one from Eastern Cape, three from Gauteng and three from Western Cape Province).

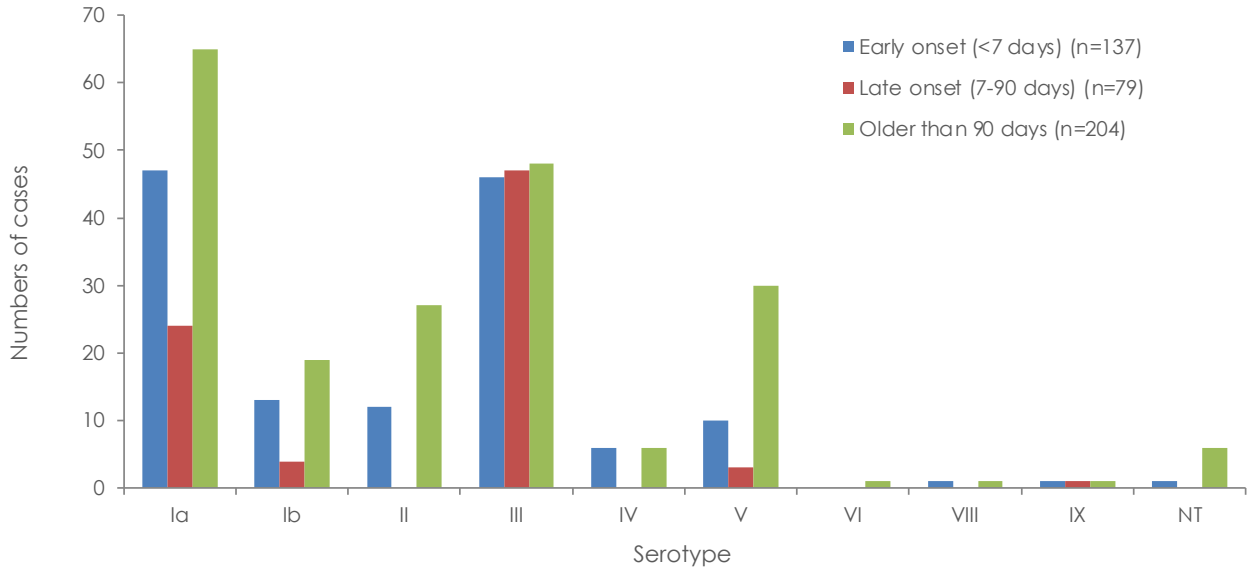

Figure 24a. Numbers of cases of laboratory-confirmed, invasive group B streptococcal disease by serotype, reported to GERMS-SA, South Africa, 2023, N=1003 (typing done for n=420)

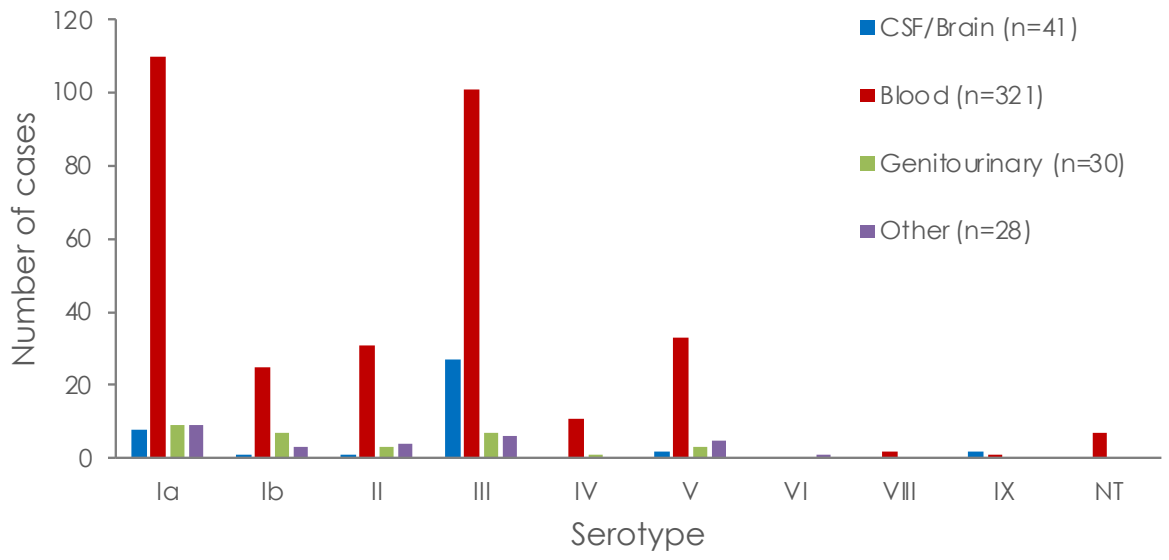

Figure 24b. Numbers of cases of laboratory-confirmed, invasive group B streptococcal disease by serotype and specimen type, reported to GERMS-SA, South Africa, 2023, N=1003 (typing done for n=420)

Discussion

Neonates carry a large burden of invasive group B strep disease in South Africa. Smaller numbers of cases identified in some provinces may reflect lower rates of blood cultures performed, particularly amongst hospitalised neonates. Over three-quarters of pregnancies in women with laboratory-confirmed intrauterine group B strep infection ended with death of the foetus/neonate. Adults and the elderly are also at risk of invasive group B strep disease. Most invasive disease was caused by serotypes I through V, which are similar to the serotypes contained in candidate vaccines undergoing phase III trials. Penicillin susceptibility is still high, supporting its use as first-line antimicrobial treatment of neonatal sepsis.

Enteric fever (typhoid and paratyphoid fever): *Salmonella enterica* serovar Typhi and *Salmonella enterica* serovars Paratyphi A, Paratyphi B, and Paratyphi C

Results

A total of 155 cases of laboratory-confirmed enteric fever were identified through the enteric fever surveillance programme of the Centre for Enteric Diseases in 2023.

The cases include *Salmonella* Typhi isolated from all sample sites, of which 79% (123/155) were blood cultures. There were two cases of enteric fever caused by *Salmonella enterica* serovars Paratyphi A and Paratyphi B. En-teric fever cases were reported from all provinces (Table 23), but the majority (113/155, 73%) were reported from two provinces: Gauteng (80/155, 52%) and Western Cape 33/155 (21%). Most cases (127/155 (82%)) were identified in the public health sector (Table 23). The highest number of cases was reported in children aged 5–14 years (36/155, 23%), followed by children aged 0–4 years (27/155, 17%), then adults aged 25–34 years (26/155, 17%), and adolescents and young adults aged 15 to 24 years (25/155, 16%), as shown in Table 24. A comparison of cases by month shows higher case numbers in January to May 2023, with another spike in August (Figure 25). A comparison of the distribution of *Salmonella* Typhi cases by month for 2021-2023 is shown in Figure 26.

Of the isolates received and tested at the centre, 98% (126/129) were susceptible to ciprofloxacin and 100% (129/129) were susceptible to azithromycin according to CLSI breakpoints (Table 25).

Forty-five (45/155; 29%) cases were reported from ESS, and 31/45 (69%) had additional information of variable completeness available (Table 26). Patients were aged between 0 and 57 years, with a median age of 13 years. HIV status was known for 21/31 (68%), of which 5/21 (24%) were HIV-infected. One (1/31; 3%) death was reported (Table 4).

Table 23. Number of cases of *Salmonella* Typhi and Paratyphi A and B by health sector and province, South Africa, 2023, n = 155 (including audit reports, missing isolates, mixed and contaminated cultures)

Province	Private sector	Public sector	Total
Eastern Cape	0	6	6
Free State	1	3	4
Gauteng	18	62	80
KwaZulu-Natal	0	14	14
Limpopo	0	2	2
Mpumalanga	1	5	6
Northern Cape	1	1	2
North West	2	6	8
Western Cape	5	28	33
South Africa	**28**	**127**	**155**

Table 24. Number of cases of *Salmonella* Typhi and Paratyphi A and B by health sector and age category, South Africa, 2023, n = 155 (including audit reports)

Age category (years)	Private sector	Public sector	Total
0 - 4	2	25	27
5 - 14	6	30	36
15 - 24	3	22	25
25 - 34	3	23	26
35 - 44	7	8	15
45 - 54	3	8	11
55 - 64	1	5	6
≥ 65	2	0	2
Unknown Age	1	6	7
Total	**28**	**127**	**155**

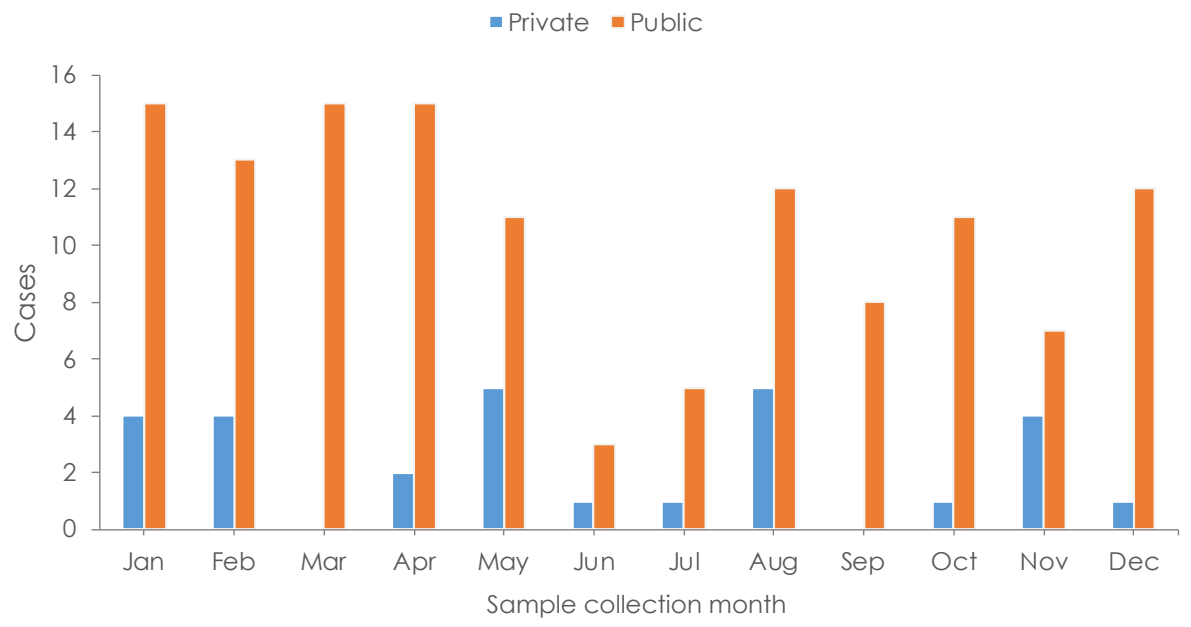

Figure 25. Number of cases of *Salmonella* Typhi by month of sample collection and health sector, South Africa, 2023, n = 153

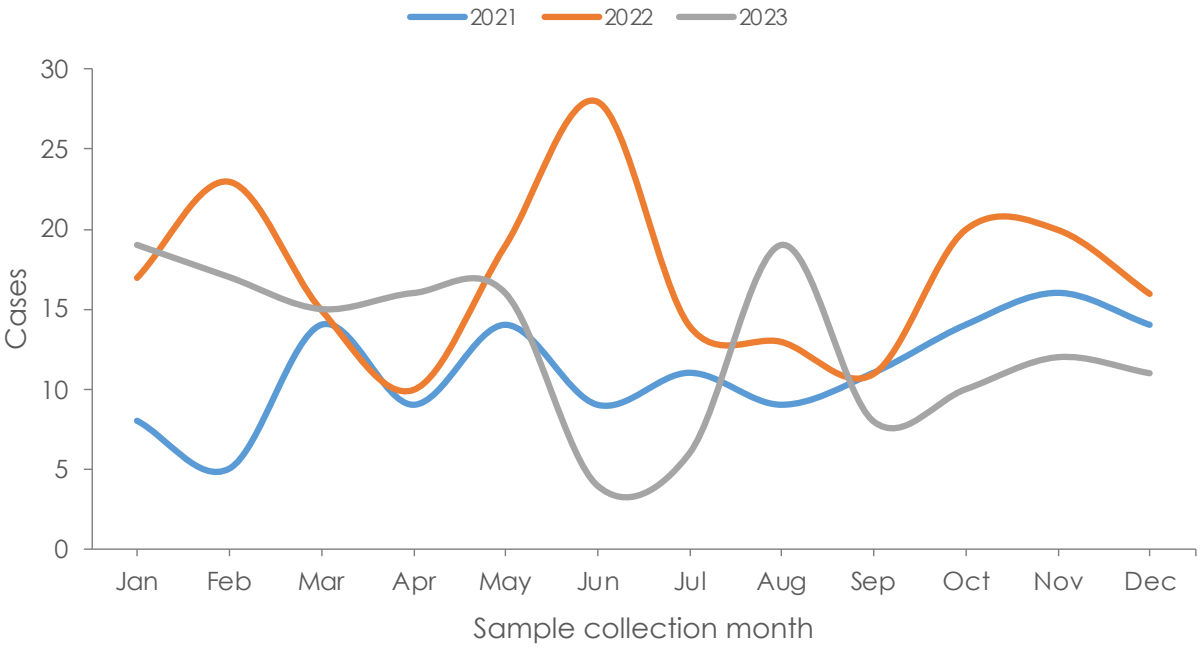

Figure 26. Number of cases of *Salmonella* Typhi reported by month and year of sample collection, South Africa, 2021 – 2023

Table 25. Ciprofloxacin and azithromycin susceptibility* of viable *Salmonella* Typhi isolates received and tested at the Centre for Enteric Diseases, South Africa, 2023, n = 129

Antimicrobial agent	Susceptible, n (%)	Non-susceptible, n (%)
Ciprofloxacin	126 (98)	3 (2)
Azithromycin	129 (100)	0 (0)

*According to CLSI breakpoints

Table 26: Number and percentage of cases of *Salmonella* Typhi and Paratyphi A and B reported from ESS by province, South Africa, 2023 (n = 45)

Province	Total cases	Cases reported from ESS		Completed case reports	
		n	%	n	%
Eastern Cape	6	0	0	0	0
Free State	4	1	25	1	100
Gauteng	80	17	21	12	71
KwaZulu-Natal	14	6	43	2	33
Limpopo	2	1	50	1	100
Mpumalanga	6	2	33	2	100
Northern Cape	2	1	50	0	0
North West	8	3	38	3	100
Western Cape	33	14	42	10	71
South Africa	**155**	**45**	**29**	**31**	**69**

Discussion

Enteric fever caused by *Salmonella* Typhi remains endemic in South Africa. Following the outbreaks in 2005–2006, the number of culture-confirmed cases annually remained stable at <150 cases per year from 2006 through 2021. In 2021, the highest annual total number of cases since 2006 was reported (n=133). In 2022, this increased to a total of 204 cases, then decreased to 155 cases in 2023. Consistent with previous years, the highest number of cases was reported in the 5–14-year age group.

Although small, localised outbreaks of enteric fever were identified in 2023, most cases were sporadic. The majority of cases acquired *Salmonella* Typhi infection in South Africa; few cases were imported (travel-related), mostly from neighbouring countries. The increase in the number of cases observed in January and in August was mainly driven by cases reported from the Johannesburg Metro and West Rand District in Gauteng Province, respectively. Most of the cases were part of the Klerksdorp outbreak strain as defined by the genetic relatedness of isolates on core-genome multilocus sequence typing analysis of whole genome sequencing data. This strain has been circulating in the North West and Gauteng Provinces since 2021, with more cases being identified in Gauteng during 2023. In 2022, there was an increase in cases in June, driven by isolates that formed part of the Klerksdorp outbreak (Figure 26). *Salmonella* Typhi isolates from both invasive and non-invasive sites were included in these analyses, as both added to the burden of infection in South Africa and represent a public health risk. The diagnosis of enteric fever remains challenging, and reported cases significantly under-represent the true number of cases. Heightened clinical awareness and appropriate laboratory tests are critical in identifying cases. Culture remains the gold standard for confirming enteric fever, so prevailing clinician testing behaviour heavily influences the likelihood of detecting cases. Greater numbers of cases reported from the Gauteng and the Western Cape Provinces could in part reflect healthcare-seeking behaviour and prevailing clinician testing practices.

The proportion of isolates showing resistance to ciprofloxacin (2%) is significantly lower than recent years; however, resistance remains a concern. *Salmonell*a Typhi isolates should routinely be tested against azithromycin, which is an alternative oral antibiotic option for treating disease caused by ciprofloxacin-resistant strains. Ceftriaxone may also be used as an alternative therapy but needs to be administered parenterally. Cases of enteric fever caused by *Salmonella enterica* serovars Paratyphi A, Paratyphi B, or Paratyphi C remain uncommon in South Africa, with only two cases reported in 2023, one Paratyphi B var Java from the Northern Cape and one Paratyphi A from the Western Cape.

Nontyphoidal *Salmonella enterica* (NTS)

Results

A total of 3162 cases of non-typhoidal salmonellosis, from all sample sites, were reported through the surveillance programme in 2023. Of these, 33% (1033/3162) were indicative of invasive disease (Table 27). Sixty-seven per cent of the total cases (2124/3162) were identified in the public health sector. There was a striking difference in the proportion of invasive cases in the public health sector (917/2124; 43%) versus those in the private health sec-tor (116/1038; 11%). This could be due in part to differences in health-seeking behaviour and diagnostic practices among clinicians in the respective health sectors.

The highest numbers of cases of invasive disease were reported from Gauteng (417/1033; 40%), followed by the Western Cape (237/1033; 23%) and KwaZulu-Natal (112/1033; 11%) Provinces (Table 27).

Gauteng also reported the highest number of cases of non-invasive disease (794/2129; 37%), followed by the Western Cape (381/2129; 18%) and KwaZulu-Natal (301/2129; 14%) Provinces. As in previous years, although seasonal prevalence was noted for non-invasive disease (lower numbers of cases identified in the winter months), no overt seasonal pattern was noted with invasive disease (Figure 27). Non-invasive disease was highest in children younger than five years (445/2129; 21%), followed by persons aged 35 to 44 years (317/2129; 15%) and persons aged ≥65 years (259/2129; 12%), as shown in Table 28. Invasive disease was most common in persons aged 35 to 44 years (193/1033; 19%), followed by children younger than five years (187/1033; 18%) and persons aged 25 to 34 years (166/1033; 16%; Table 28). Most invasive cases were identified from blood cultures (922/1033; 89%; Table 29).

A total of 2251 viable isolates were received and serotyped; this included isolates submitted as part of routine laboratory-based surveillance as well as isolates submitted for outbreak investigation purposes. A total of 74 serovars were identified, but two serovars accounted for 76% of the cases: *Salmonella* Enteritidis (1417/2251; 63%) and *Salmonella* Typhimurium (301/2251; 13%). The next most common serovars were *Salmonella enterica* subspecies salamae, *Salmonella* Isangi, *Salmonella* Muenchen, and monophasic *Salmonella* Typhimurium (Table 30). Proportions of common serovars differed among provinces, but *Salmonella* Enteritidis was the most common serovar in all provinces (Figure 28). Antimicrobial susceptibility testing was not routinely performed but was available upon request. Of the 782 isolates at the centre, 98% (768/782) were susceptible to ciprofloxacin, and 98% (768/782) were susceptible to azithromycin according to CLSI breakpoints (Table 31).

Table 27. Number of cases of invasive and non-invasive nontyphoidal salmonellosis by province, South Africa, 2023, n = 3162 (including audit reports)

Province	Non-invasive	Invasive	Total
Eastern Cape	240	103	343
Free State	130	42	172
Gauteng	794	417	1211
KwaZulu-Natal	301	112	413
Limpopo	64	33	97
Mpumalanga	98	40	138
Northern Cape	26	14	40
North West	95	35	130
Western Cape	381	237	618
South Africa	**2129**	**1033**	**3162**

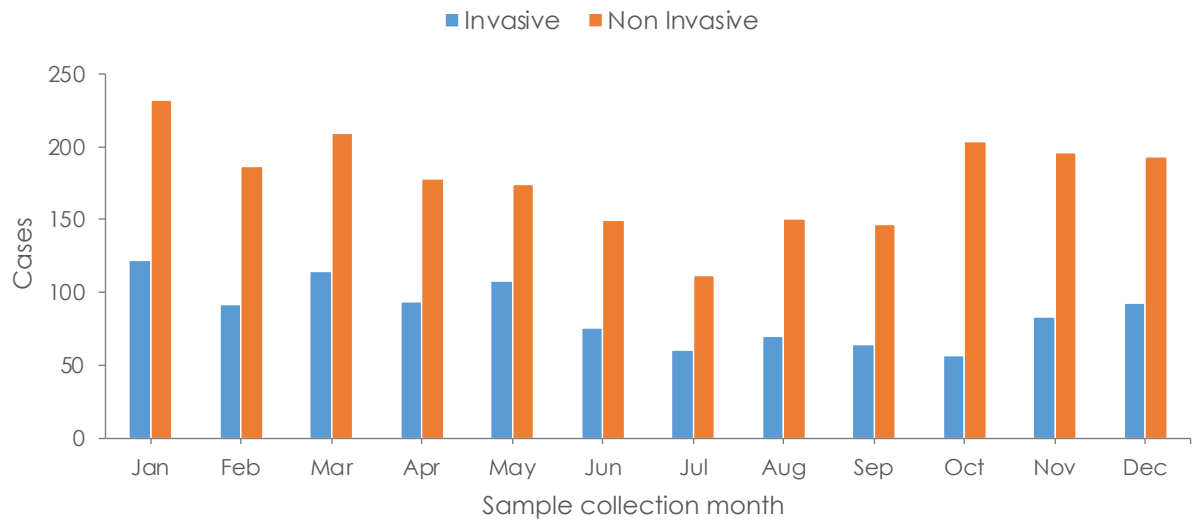

Figure 27. Number of cases of non-invasive (n = 2129) and invasive (n = 1033) nontyphoidal salmonellosis by month, South Africa, 2023

Table 28. Number of cases of invasive and non-invasive nontyphoidal salmonellosis by age category, South Africa, 2023, n = 3162 (including audit reports)

Age category (years)	Non-Invasive	Invasive	Total
0 - 4	445	187	632
5 - 14	177	23	200
15 - 24	133	53	186
25 - 34	247	166	413
35 - 44	317	193	510
45 - 54	240	128	368
55 - 64	209	99	308
≥ 65	259	110	369
Unknown	102	74	176
Total	**2129**	**1033**	**3162**

Table 29. Number of cases of nontyphoidal salmonellosis reported by primary anatomical site of isolation, South Africa, 2023, n = 3162 (including audit reports).

Specimen	n	%
Stool	1675	53
Blood culture	922	29
Urine	233	7
CSF	21	1
Bone marrow	2	0
Other*	309	10
Total	**3162**	**100**

*Includes respiratory samples, abscess, catheter tips, superficial and deep swabs, tissue samples

Table 30. Six most common *Salmonella enterica* serovars by province, South Africa, 2023, N = 1899*

Province	*Salmonella* Enteritidis	*Salmonella* Typhimurium	*Salmonella salamae*	*Salmonella* Isangi	*Salmonella* Muenchen	Typhimurium monophasic
Eastern Cape	127	55	6	20	3	9
Free State	75	24	7	0	5	3
Gauteng	607	71	30	13	5	7
KwaZulu-Natal	125	32	10	0	6	1
Limpopo	41	9	3	4	0	0
Mpumalanga	53	7	3	7	2	0
Northern Cape	13	8	1	0	0	0
North West	59	5	6	2	0	1
Western Cape	317	90	7	1	10	9
South Africa	**1 417**	**301**	**73**	**47**	**31**	**30**

*Includes nontyphoidal *Salmonella* isolates from invasive and non-invasive cases

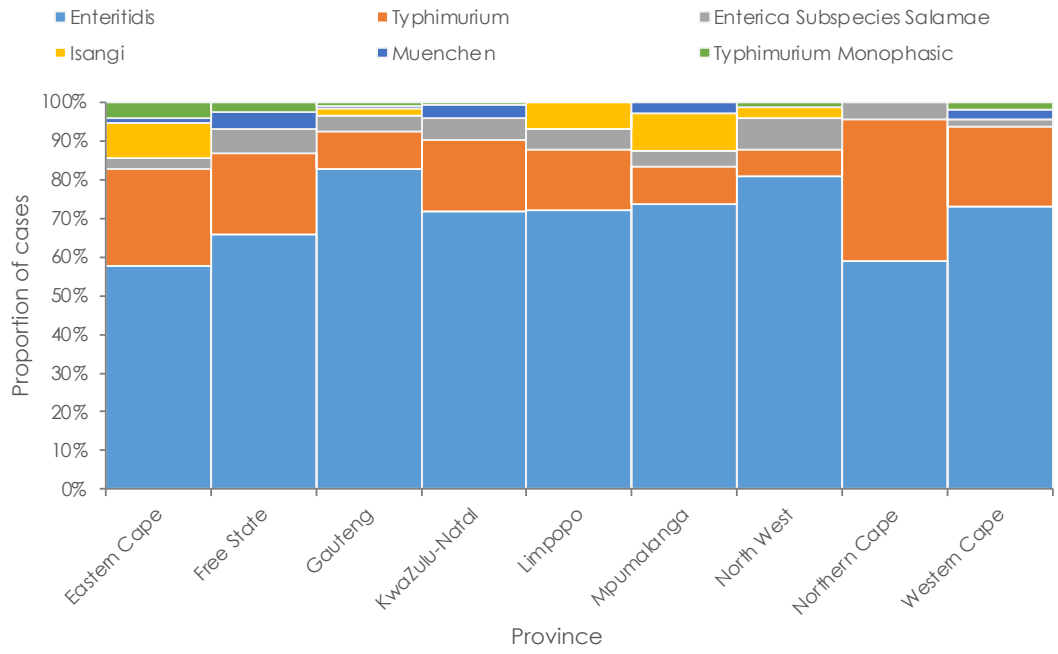

Figure 28. Proportions of the six most common *Salmonella enterica* serovars causing nontyphoidal salmonellosis by province, South Africa, 2023, N = 1899.

Table 31. Ciprofloxacin and azithromycin susceptibility* of viable nontyphoidal *Salmonella* isolates received and tested at the Centre for Enteric Diseases, South Africa, 2023, n = 782

Antimicrobial agent	Susceptible, n (%)	Non-susceptible, n (%)
Ciprofloxacin	768 (98)	14 (2)
Azithromycin	769 (98)	13 (2)

*According to CLSI breakpoints

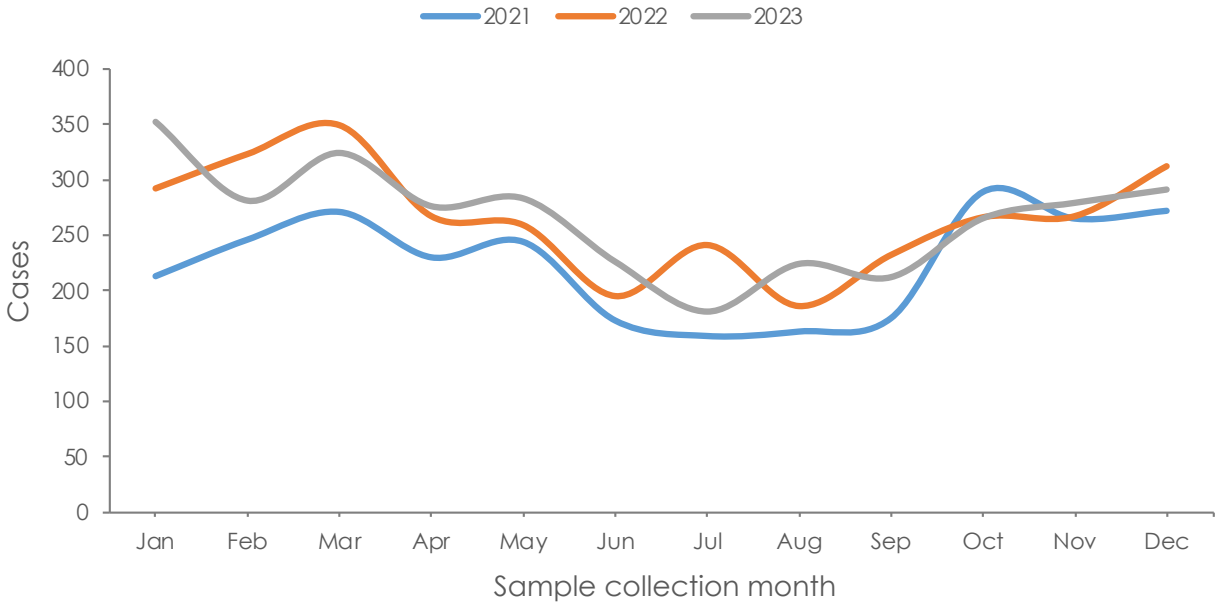

Figure 29. Number of cases of nontyphoidal *Salmonella* by month and year, South Africa, 2021 - 2023

Discussion

Non-typhoidal salmonellosis is usually foodborne and typically manifests as acute gastroenteritis. Invasive disease is usually associated with HIV infection or the presence of other risk factors.

Similar case numbers were reported in 2023 (n = 3162) and 2022 (n = 3185) (Figure 29). As in previous years, although seasonal prevalence was noted for non-invasive disease (increased numbers in the earlier months of the year and low numbers in the winter months), invasive disease showed no seasonality.

Greater numbers of invasive disease reported from the Gauteng and Western Cape Provinces may reflect healthcare seeking behaviour and clinician testing practices. Children younger than 5 years bear the highest burden of non-invasive disease, but invasive disease was reported more commonly in adults aged 35-44 years; as in previous years, this is likely the effect of a high proportion of HIV-infected cases in this age group.

Salmonella Enteritidis was the predominant serovar, followed by *Salmonella* Typhimurium, a pattern observed since 2012. Provincial differences in serovar proportions might reflect local transmission dynamics or undetected outbreaks and require further investigation.

Shigella species

Results

A total of 952 culture-confirmed cases of shigellosis were reported through the surveillance programme in 2023. Most cases (712/952; 75%) were identified in the public health sector (Table 32). The total includes *Shigella* spp. isolated from all sample sites, but in 90% (855/952) of the cases the isolate was recovered from stool or rectal swab samples reflecting non-invasive dysentery or diarrhoea. In the remaining 10% of cases, the isolate was recovered from blood culture (42/952; 4%) or other extra-intestinal sample sites (55/952; 6%) (Table 33).

The highest number of shigellosis cases occurred in January, March, and August (Figure 30). Thirty-seven per cent of cases were reported from Western Cape Province (352/952), with the Gauteng and KwaZulu-Natal provinces contributing 26% (243/952) and 14% (136/952) of the total cases, respectively (Table 32).

The highest numbers of cases of shigellosis were reported in children younger than five years (320/952; 34%), followed by children 5 to 14 years of age (143/952; 15%). The proportion of invasive shigellosis cases remains low (42/952; 4%), and as in previous years, invasive disease was highest in children younger than five years (16/42; 38%) (Table 34).

A total of 705 viable isolates were received and serotyped, including isolates submitted as part of routine laboratory-based surveillance as well as isolates submitted for outbreak investigation purposes. Twenty-seven different serotypes were identified. The most common serovar was *S. flexneri* type 2a (224/705; 32%), followed by *S. sonnei* (135/705; 19%), *S. flexneri* type 3a (83/705; 12%), and *S. flexneri* type 1b (81/705; 12%). The next most common serotypes were *S. flexneri* type 6 and *S. flexneri* type 4 (Table 35). Proportions of the serotypes differed among provinces (Figure 31), with *S. flexneri* type 2a predominating in three provinces (Western Cape, Eastern Cape, and Free State). In the Gauteng, KwaZulu-Natal, and Limpopo provinces, *S. sonnei* dominated. Antimicrobial susceptibility testing was not routinely performed but was available upon request. Of those isolates where susceptibility testing was performed, 100% (28/28) were susceptible to ciprofloxacin and 96% (27/28) were susceptible to azithromycin (Table 36).

Table 32. Number of cases of shigellosis by health sector and province, South Africa, 2023, n = 952 (including audit reports)

Specimen	Private sector	Public sector	Total
Eastern Cape	8	99	107
Free State	21	28	49
Gauteng	138	105	243
KwaZulu-Natal	50	86	136
Limpopo	0	12	12
Mpumalanga	8	10	18
Northern Cape	0	10	10
North West	13	12	25
Western Cape	2	350	352
South Africa	**240**	**712**	**952**

Table 33. Number of non-invasive and invasive or extraintestinal cases of shigellosis reported by primary anatomical site of isolation, South Africa, 2023, n = 952 (including audit reports)

Specimen	n	%
Stool	855	90
Blood culture	42	4
Urine	33	3
Other	22	2
Total	**952**	**100**

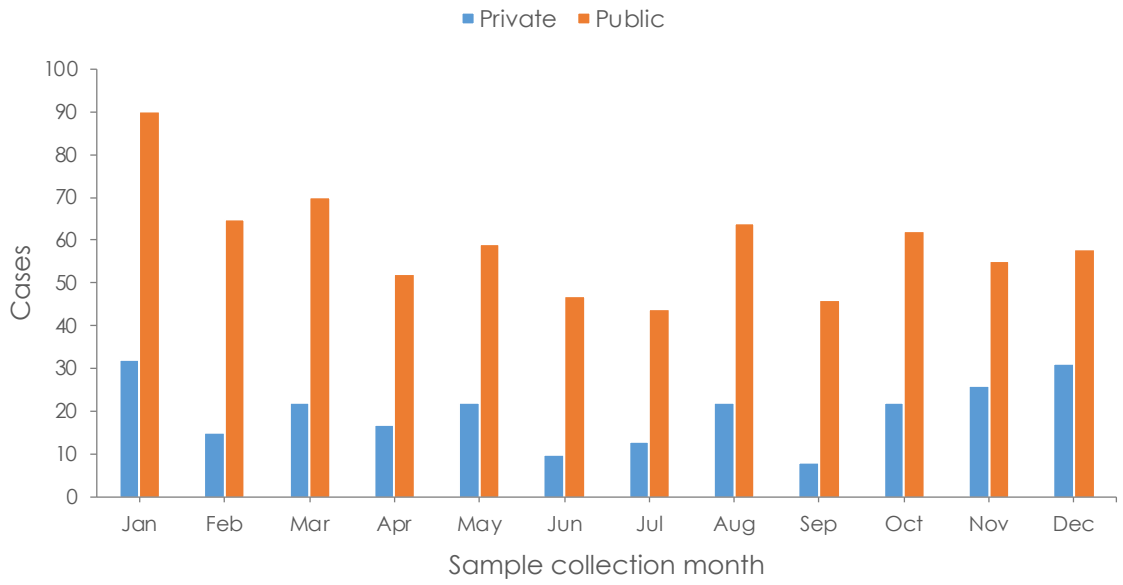

Figure 30. Number of cases of shigellosis by month and health sector, South Africa, 2023, n = 952 (including audit reports)

Table 34. Number of non-invasive and invasive or extraintestinal cases of shigellosis reported by age category, South Africa, 2023, n = 952 (including audit reports)

Age category (years)	Non-invasive	Extraintestinal	Invasive	Total
0 - 4	292	12	16	320
5 - 14	134	8	1	143
15 - 24	56	9	0	65
25 - 34	78	9	1	88
35 - 44	94	8	3	105
45 - 54	61	1	3	65
55 - 64	46	2	7	55
≥ 65	70	6	9	85
Unknown	24	0	2	26
Total	**855**	**55**	**42**	**952**

Table 35. Six most common *Shigella* species (and serotype where applicable) by province, South Africa, 2023, N = 595*

Province	*S. flexneri* 2a	*S. sonnei* Phase II	*S. flexneri* Type 3a	*S. flexneri* Type 1b	*S. flexneri* Type 6	S. flexneri Type 4
Eastern Cape	20	6	16	13	4	4
Free State	13	10	2	3	2	0
Gauteng	55	57	18	10	15	5
KwaZulu-Natal	17	23	1	11	2	4
Limpopo	0	4	0	0	0	0
Mpumalanga	3	3	0	1	1	0
Northern Cape	0	0	2	1	2	0
North West	4	8	2	0	1	0
Western Cape	112	24	42	42	20	12
South Africa	**224**	**135**	**83**	**81**	**47**	**25**

*Includes Shigella isolates from invasive, extraintestinal and non-invasive cases

Table 36. Ciprofloxacin and azithromycin susceptibility* of viable *Shigella* isolates received from invasive disease and tested at the Centre for Enteric Diseases, South Africa, 2023, n = 28

Antimicrobial agent	Susceptible, n (%)	Non-susceptible, n (%)
Ciprofloxacin	28 (100)	0 (0)
Azithromycin	27 (96)	1 (4)

*According to CLSI breakpoints

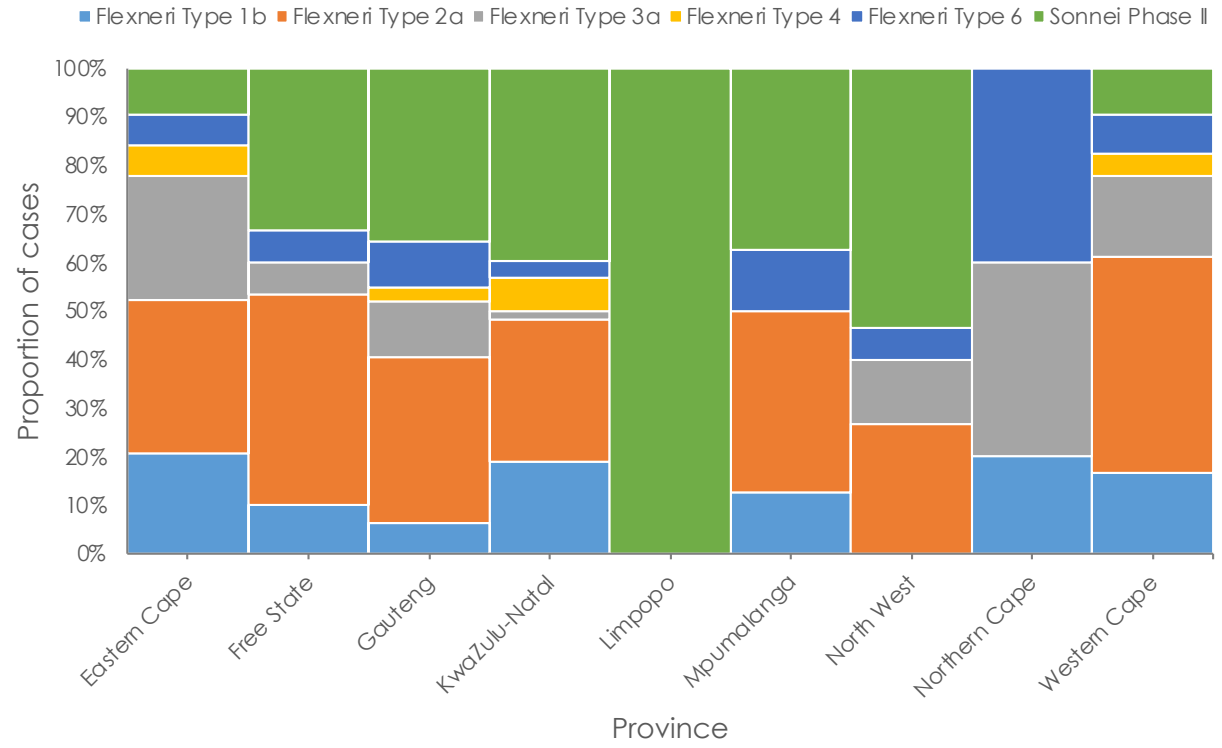

Figure 31. Proportions of the most common *Shigella* species and serotypes by province, South Africa, 2023, N = 595.

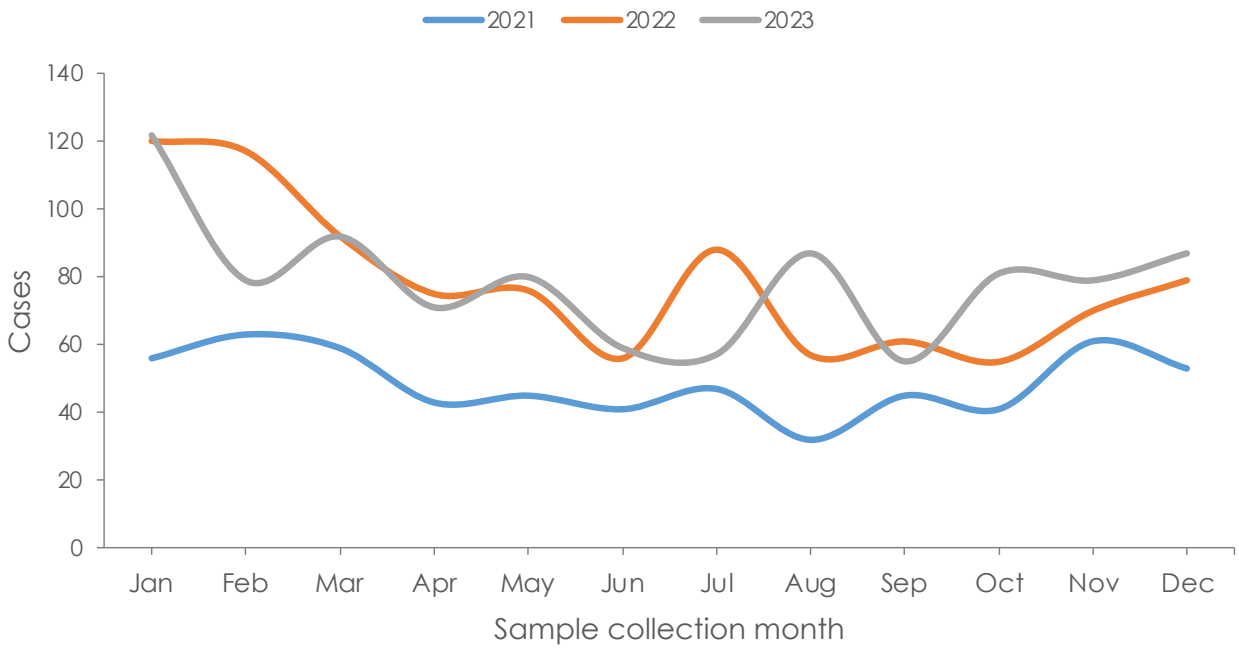

Figure 32. Number of cases of shigellosis by month and year, South Africa, 2021 - 2023 (including audit reports)

Discussion

Although *Shigella* infection has been associated with waterborne outbreaks in South Africa, person-to-person transmission plays an important role. Children younger than five years continue to bear the highest burden of shigellosis. The primary manifestation of disease due to *Shigella* is non-invasive dysentery or diarrhoea, and invasive disease is uncommon.

Similar case numbers were reported in 2022 (n = 948) and 2023 (n = 952). As in 2022, increased numbers of cases were identified in the earlier months of the year. No typical pattern of seasonality was noted in Figure 32.

Although proportions differ, as in previous years, *S. flexneri* type 2a and *S. sonnei* were two of the three commonest serotypes. Provincial differences in serotype proportions might reflect local transmission dynamics or undetected outbreaks.

Campylobacter species

Results

Only cases of campylobacteriosis for which isolates were received from diagnostic laboratories are reported here. Audits were not performed, so cases for which isolates were not submitted are not included in the report.

Of the 694 isolates of *Campylobacter* spp. submitted through the surveillance programme in 2023, 80% (555/694) were submitted by diagnostic laboratories in the private sector (Table 37). This includes *Campylobacter* spp. isolated from all sample sites, but in 97% (675/694) of the cases the isolate was recovered from stool or rectal swab samples reflecting non-invasive diarrhoeal disease. In the remainder of the cases, the isolate was recovered from blood culture specimen (19/694; 3%).

There was no apparent seasonal pattern (Figure 33). Gauteng Province reported more than half the cases (406/694; 59%), followed by the Western Cape (186/694; 27%); these two provinces accounted for 86% of the total cases (Table 37).

Case numbers were highest in children younger than five years of age (223/694; 32%; Table 38). *Campylobacter jejuni* was the most common species identified (520/659; 79%) by PCR testing. Antimicrobial susceptibility testing is not routinely performed at the centre.

Table 37. Number of cases of campylobacteriosis by health sector and province, South Africa, 2023, n = 694*

Province	Private sector	Public sector	Total
Eastern Cape	16	23	39
Free State	22	1	23
Gauteng	380	26	406
KwaZulu-Natal	1	6	7
Limpopo	0	0	0
Mpumalanga	9	1	10
Northern Cape	0	2	2
North West	21	0	21
Western Cape	106	80	186
South Africa	**555**	**139**	**694**

* Only cases of campylobacteriosis for which isolates were received from diagnostic laboratories are reported

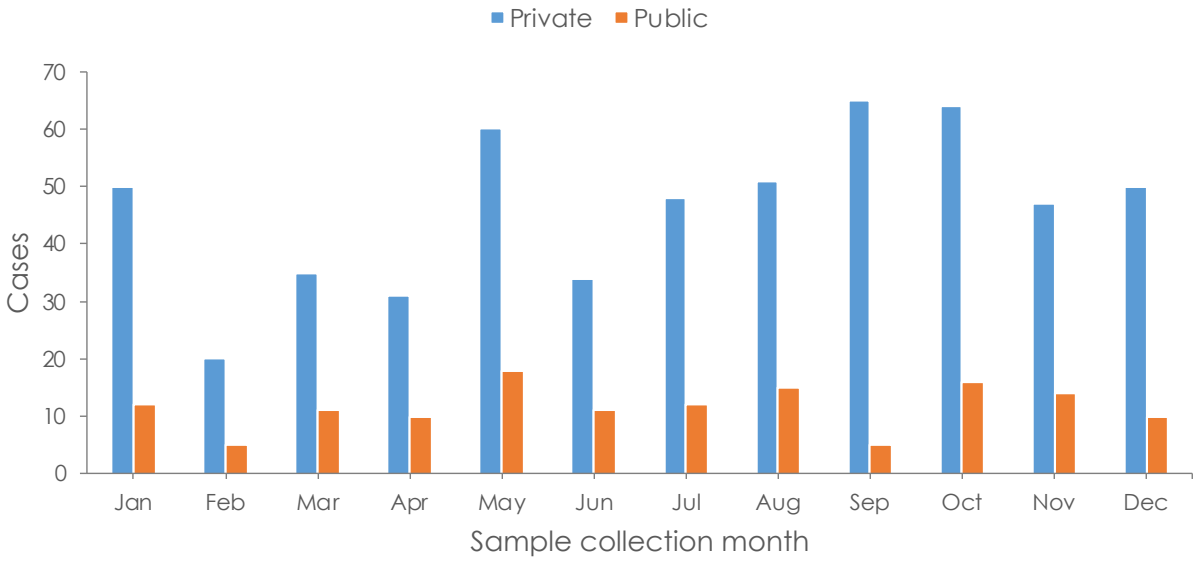

Figure 33. Number of cases of campylobacteriosis by month and health sector, South Africa, N = 694, 2023*

*Only cases of campylobacteriosis for which isolates were received from diagnostic laboratories are reported. Audits were not performed.

Table 38. Number of *Campylobacter* spp. isolates by health sector and age category, South Africa, 2023, n = 694

Age category (years)	Private sector	Public sector	n
0 - 4	174	49	223
5 - 14	73	8	81
15 - 24	47	8	55
25 - 34	59	14	73
35 - 44	40	22	62
45 - 54	58	15	73
55 - 64	37	9	46
≥ 65	61	11	72
Unknown	6	3	9
Total	**555**	**139**	**694**

Discussion

The number of *Campylobacter* spp. isolates submitted by public sector laboratories (129/694; 20%) remains low and strikingly disproportionate to the size of the population served in comparison to the number of isolates sub-mitted from the private sector. However, audits of the NHLS CDW data were not performed, and cases in the public sector are therefore under-reported. Differences in health-seeking behaviour and diagnostic practices among clinicians in the respective health sectors, as well as differences in laboratory methods utilised for culture of *Campylobacter* spp. from stool samples, are also likely contributing factors.

Listeriosis

Results

A total of 83 cases of listeriosis were notified through the NMC surveillance system in 2023. Three provinces reported 86% of the cases: Western Cape (27/83; 33%), Gauteng (24/83; 29%), and KwaZulu-Natal (20/83; 24%; Table 39). Cases were most common among adults aged 15–49 years (32/83; 39%), followed by neonates ≤28 days (21/83; 25%; Table 40).

Thirty-one of the 83 cases (37%) were detected at ESS, but listeriosis case investigation forms were only completed for 19 cases (61%) at these sites (Table 41). Patients were aged between 0 and 59 years with a median age of 30 years, with 79% (15/19) being male. Most were adults within the age group 15–49 years (12/19; 63%), followed by neonates aged below 29 days (5/19; 26%) and the elderly (2/19; 11%). HIV status was known for 79% (15/19) of the cases. One neonate was HIV-exposed (1/5) while six of the ten adults with known HIV-status were HIV positive (6/10; 60%). Six (6/19; 29%) deaths were reported. Pregnancy-associated cases accounted for 32% (6/19) of the total cases, all resulting in live births.

Table 39. Number of cases of listeriosis by health sector and province, South Africa, 2023, n = 83

Province	Private sector	Public sector	Total
Eastern Cape	3	2	5
Free State	0	2	2
Gauteng	8	16	24
KwaZulu-Natal	5	15	20
Limpopo	0	2	2
Mpumalanga	0	2	2
Northern Cape	0	0	0
North West	0	1	1
Western Cape	3	24	27
South Africa	**19**	**64**	**83**

Table 40. Number of cases of listeriosis by age group and province, South Africa, 2023, n = 83

Age category	Private sector	Public sector	Total
Neonates <29 days	1	20	21
1 month-14 years	0	4	4
15-49 years	6	26	32
50-64 years	1	6	7
65 years & older	10	4	14
Age unknown	1	4	5
South Africa	**19**	**64**	**83**

Table 41. Number and percentage of listeriosis cases reported from ESS by province, South Africa, 2023, n = 31

Province	Total cases	Cases reported from ESS		Completed case reports	
		n	%	n	%
Eastern Cape	5	0	0	0	0
Free State	2	0	0	0	0
Gauteng	24	12	50	5	42
KwaZulu-Natal	20	5	25	4	80
Limpopo	2	0	0	0	0
Mpumalanga	2	0	0	0	0
Northern Cape	0	0	0	0	0
North West	1	0	0	0	0
Western Cape	27	14	52	10	71
South Africa	**83**	**31**	**37**	**19**	**61**

Discussion

The number of listeriosis cases for 2023 (n = 83) is below the expected range of annual cases (119–298) based on the estimated incidence of sporadic cases (2–5 cases per million populations per year). The distribution of cases by province and age group is similar to that reported in 2022.

Vibrio cholerae

Results

A total of 193 isolates were tested at the Centre for Enteric Diseases in 2023, including culture, serotyping, and/or PCR. All were confirmed as *Vibrio cholerae* and further characterised as toxigenic serogroup 01 *Vibrio cholerae* (186 cases, considered to be cholera cases) and non-toxigenic, non-01 *Vibrio cholerae* (seven cases that do not meet the case definition for cholera) (Table 42). The vast majority of isolates confirmed as cholera cases at the centre were from the Gauteng Province (178/186; 96%). Most cases occurred in the 35–44-year age group (38/186; 20%), followed by the 45–54 year (30/186; 16%) and 25–34 year (25/186; 13%) age groups (Table 43). Antimicrobial susceptibility testing was performed on 146 *Vibrio cholerae* O1 isolates, and all were susceptible to azithromycin and ciprofloxacin (Table 44). In addition, 68 stool specimens were received and tested using PCR, of which 55 were negative for the cholera-toxin ctxA gene (do not meet the case definition for cholera), while 13 were positive for the cholera-toxin ctxA gene (considered to be cholera cases) (Table 45).

Discussion

Prior to this reporting period, the last case of toxigenic *Vibrio cholerae* 01 was identified in South Africa in 2020. From 1 January through 31 March 2023, 11 confirmed cholera cases were identified (toxigenic *Vibrio cholerae* O1 serotype Ogawa) in Gauteng (Ekurhuleni and City of Johannesburg), and in February 2023, a cholera outbreak was declared in South Africa. The initial three cases were imported or import-related cases following travel to Malawi, while subsequent cases acquired infection locally. Most cases were reported from May through July 2023, primarily from the City of Tshwane in Gauteng. Only isolates/stool specimens tested at the centre are in-cluded in this report. Cases of nontoxigenic non-O1/non-O139 *V. cholerae* are not considered to be cholera and do not warrant a public health response.

Table 42. Number of *Vibrio cholerae* isolates tested at the Centre for Enteric Diseases by serogroup and province, 2023, n = 193*

Province	Vibrio cholerae O1	Vibrio cholerae non-O1	Total
Eastern Cape	1	2	3
Free State	1	0	1
Gauteng	178	0	178
KwaZulu-Natal	0	1	1
Limpopo	4	0	4
Mpumalanga	1	0	1
Northern Cape	0	0	0
North West	0	0	0
Western Cape	1	4	5
South Africa	**186**	**7**	**193**

* Only isolates that were received and tested at the Centre for Enteric Diseases are reported

Table 43. Number of *Vibrio cholerae* isolates tested at the Centre for Enteric Diseases by serogroup and age group, 2023, n = 193*

Age category (years)	Vibrio cholerae O1	Vibrio cholerae non-O1	n
0 - 4	9	0	9
5 - 14	21	2	23
15 - 24	14	1	15
25 - 34	25	0	25
35 - 44	38	0	38
45 - 54	30	0	30
55 - 64	13	1	14
≥ 65	17	2	19
Unknown	19	1	20
Total	**186**	**7**	**193**

*Only isolates that were received and tested at the Centre for Enteric Diseases are reported

Table 44. Ciprofloxacin and azithromycin susceptibility* of viable *Vibrio cholerae* isolates received and tested at the Centre for Enteric Diseases, South Africa, 2023, (N = 146)

Antimicrobial agent	Susceptible, n (%)	Non-susceptible, n (%)
Ciprofloxacin	146 (100)	0 (0)
Azithromycin	146 (100)	0 (0)

*According to CLSI breakpoints

Table 45. Number of *Vibrio cholerae* PCR results of stools tested at the Centre for Enteric Diseases by province, 2023, n = 68

Province	Vibrio cholerae O1	Toxin gene negative	Total
Eastern Cape	0	0	0
Free State	7	24	31
Gauteng	5	21	26
KwaZulu-Natal	1	0	1
Limpopo	0	3	3
Mpumalanga	0	5	5
Northern Cape	0	0	0
North West	0	1	1
Western Cape	0	1	1
South Africa	**13**	**55**	**68**

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SUMMARY

In 2023, GERMS-SA continued to serve as a vital laboratory-based surveillance program at the NICD, offering valuable pathogen-specific trend data. Several smaller sites experienced a slower start to the year, with fewer laboratory-confirmed cases than expected. Patient flow was further impacted at some locations by structural issues such as planned renovations and patient discharges occurring before alerts were issued, all of which contributed to lower consenting and interview rates. Expanding patient interviews within surveillance is expected to improve data depth and accuracy, supporting more targeted public health interventions. Despite these challenges, CRF completion rates remained strong. Patient alerts from SDW and NMC aided in tracking individuals meeting case definitions, while data quality continued to improve through regular training and audits for surveillance officers. Additionally, 5-Flucytosine (5FC) was added to the Essential Medicines List and became accessible via a national tender in October 2023, enhancing availability of this essential treatment.

Opportunistic infections: The number of **cryptococcal** disease episodes remained stable from 2022 to 2023, indicating a continued significant healthcare burden, with many patients requiring hospitalisation. The in-hospital mortality rate remained high, especially among those who did not receive flucytosine-based induction therapy, despite treatment guidelines recommending its use. The majority of ***E. coli*** cases were concentrated in Gauteng and KwaZulu-Natal provinces, with over half originating from the bloodstream. Hospital-acquired infections were associated with lower antibiotic susceptibility, especially to third- and fourth-generation cephalosporins and fluoroquinolones. While carbapenem susceptibility remained stable, ongoing monitoring is essential, particularly for carbapenemase-producing *E. coli* mediated by OXA-48. In **non-typhoidal salmonellosis**, HIV infection remains the single most important risk factor for invasive disease and is reported more commonly in adults aged 35–44 years. The higher numbers in Gauteng and the Western Cape provinces likely reflect differences in healthcare-seeking behaviour and testing practices.

Vaccine-preventable diseases: The 2023 data continue to monitor trends in invasive pneumococcal disease (IPD) and *Haemophilus influenzae* type b (HIb), post-EPI vaccine introduction of PCV13 and Hib booster (2009). Incidence of **invasive HI (notifiable medical condition)** has remained similar to that of 2022. Non-typeable HI dominated, followed by type B (Hib), especially in infants. Approximately 30% of HI cases were fatal, particularly among infants and the elderly. Vaccination records for children with Hib infection showed that all were appropriately vaccinated for age, with some too young for the booster dose. The high rate of ampicillin-resistant isolates across serotypes indicates a need for ongoing monitoring into 2024. The Western Cape province's high incidence rate may be linked to increased specimen collection, emphasising the importance of surveillance in this region. Incidence of **IPD** is still lower than pre-COVID-19 levels. The Western Cape province showed the highest IPD incidence, with infants and adults aged 45-64 years being most affected. Resistance to penicillin and ceftriaxone was observed. In-hospital fatality was 33%, especially among those with meningitis. Serotypes 3 and 8 were the top disease-causing serotypes in both children and adults, with serotypes 19F, 19A, and 3 among the PCV13 serotypes causing the most disease in children. IPD incidence trends in 2023 highlighted the persistent high burden in certain demographics, particularly infants and adults with comorbidities. With South Africa's shift to PCV10 (CIPLA) in 2024, ongoing surveillance of serotype-specific IPD will be critical to monitor the impacts of this change on disease trends. Infants under one year and adults over 64 years of age showed the highest incidence of **invasive group B strep disease**. Serotypes III, Ia, and V were predominant. Mortality in neonates reached 17%, with significant maternal and neonatal risk factors associated with group B strep. Surveillance underscores the importance of emerging vaccines containing prevalent serotypes.

Epidemic-prone diseases (Notifiable medical conditions): The incidence of **invasive meningococcal disease** in 2023 marked a 53% increase from 2022, with the Western Cape province showing the highest rates. Cases predominantly involved infants and were largely serogroup B, with significant penicillin resistance observed. Enhanced surveillance sites showed an 11% in-hospital fatality rate, with some patients experiencing long-term sequelae. In 2023, the highest number of **enteric fever** cases originated from Gauteng and the Western Cape; children aged 5–14 years were the most affected. There was low ciprofloxacin resistance (2%); all isolates were azithromycin-susceptible. Outbreaks remained sporadic, with most cases acquired locally. Diagnostic awareness is key due to under-reported cases. Highest ***Shigella*** cases were in children <5 years of age, with low invasive disease (4%). The predominant serotypes were *S. flexneri* type 2a and *S. sonnei*. Children were the most affected by non-invasive shigellosis. Transmission was largely person-to-person. The number of **listeriosis** cases for 2023 (83) were mostly from the Western Cape, Gauteng, and KwaZulu-Natal provinces and primarily affected adults aged 15-49 years of age and neonates. The number of cases was lower than expected; distribution patterns mirrored the previous year. The majority (96%) of **cholera** cases were from Gauteng province, particularly affecting adults aged 35-44 years of age. All tested isolates showed susceptibility to azithromycin and ciprofloxacin. Following the first confirmed case in three years, an outbreak was declared in February 2023, initially linked to imported cases from Malawi. The local spread primarily affected the City of Tshwane from May to July. Non-toxigenic strains did not warrant a public health response. The highest case numbers of **campylobacteriosis** were mainly from private-sector laboratories. Gauteng and the Western Cape provinces accounted for 86% of cases, with children <5 years of age making up the largest age group affected. *Campylobacter jejuni* was the most commonly identified species. Public sector submissions were notably lower, likely due to differences in health-seeking behaviours, diagnostic practices, and laboratory methods, which may lead to under-reporting. **Invasive group A strep** maintained pre-pandemic incidence levels. The Western Cape, Gauteng, and Eastern Cape provinces had the highest cases, affecting mainly infants and the elderly. All isolates remained susceptible to first-line antimicrobials, with 20% in-hospital mortality, often within a day of admission.

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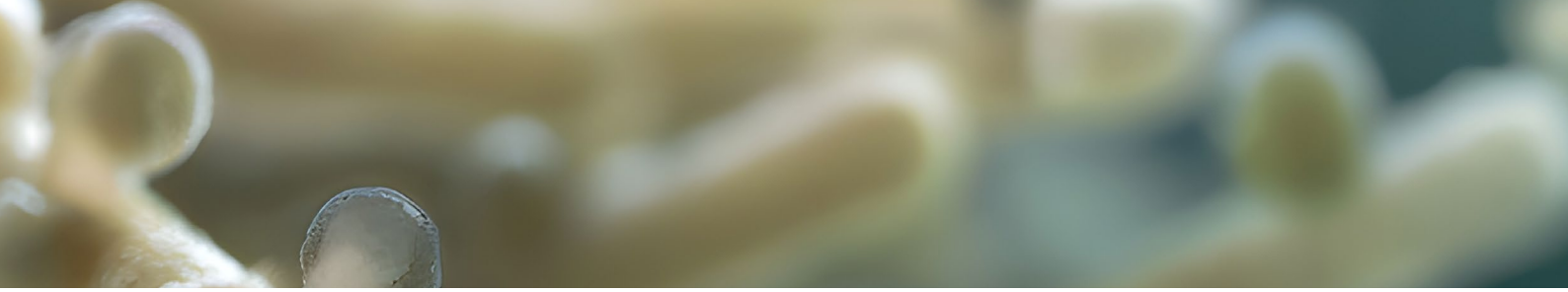

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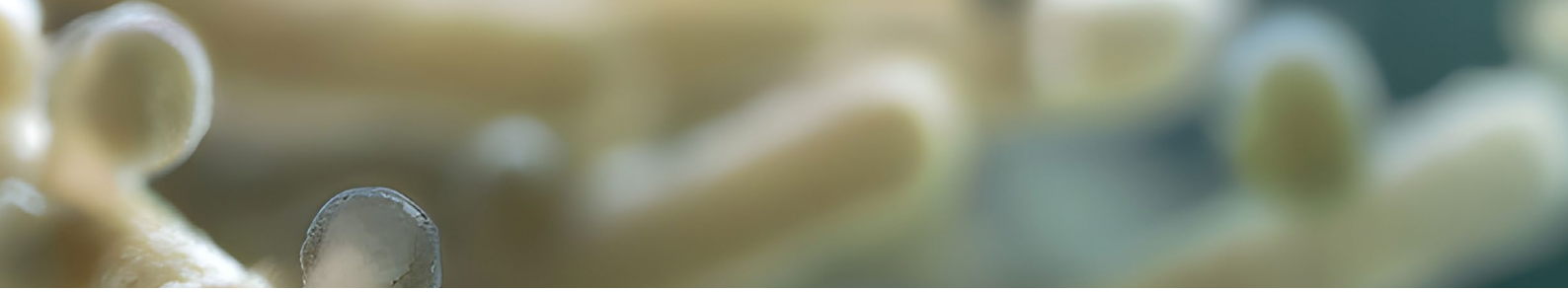

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