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GERMS-SA: ANNUAL SURVEILLANCE REVIEW 2022 - Key findings

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Summary

GERMS-SA performs national, population-based surveillance for laboratory-confirmed bacterial and fungal infections of public health importance in South Africa. We report key findings from the GERMS-SA: Annual Surveillance Review 2022. Clinical microbiology laboratories reported case patients to the National Institute for Communicable Diseases (NICD) using laboratory case report forms, according to standard case definitions. For a subset of cases, we obtained clinical patient details concerning the course of disease. The GERMS-SA surveillance programmes detected 12 995 cases in 2022. Using these data, GERMS-SA aims to provide accurate, quality-controlled strategic information for patient management and public health policymakers to influence health practice planning, implementation, and evaluation for the infections under surveillance.

Introduction

GERMS-SA performs national, population-based, laboratory surveillance for bacterial and fungal infections in South Africa. The surveillance is a collaborative effort between the National Institute for Communicable Diseases (NICD), a division of the National Health Laboratory Service (NHLS), participating South African clinical microbiology laboratories and selected public hospitals. Laboratory surveillance comprises two levels: i) documentation of laboratory-confirmed case numbers of certain pathogens with submission of these isolates from public and private laboratories to NICD for further characterisation, and ii) enhanced sentinel site surveillance, where additional clinical data are collected on patients with laboratory-confirmed diagnoses of certain conditions at selected hospital sites.

GERMS-SA evolved through the amalgamation of multiple laboratory-based surveillance projects and has been ongoing since the early 2000s. The long-standing nature of the programme has enabled it to provide strategic information regarding trends in the pathogens of public health importance, including vaccine-preventable diseases, epidemic-prone diseases, healthcare-associated bloodstream infections, and HIV-associated opportunistic infections. Here we report key findings from the GERMS-SA: Annual Surveillance Review 2022. For the full report, please go to https://www.nicd.ac.za/wp-content/uploads/2024/02/NICD-GERMS-Annual-Report-2022.pdf.

Aims & Objectives

GERMS-SA aims to systematically collect, collate, and analyse data on pathogens of public health importance in order to provide accurate, quality-controlled, strategic surveillance information to public health policy-makers and clinical managers in South Africa, which may influence health practice planning, implementation, and evaluation of the infections under surveillance.

Specific objectives are to:

- Provide estimates of disease burden (episode numbers and incidence rates) of particular bacterial and fungal infections over time
- Describe the epidemiology of the pathogens under surveillance
- Estimate the impact of current and future vaccines on vaccine-preventable diseases
- Monitor for existing and emerging antimicrobial resistances of pathogens in the South African population
- Estimate the impact of antiretroviral therapy on various opportunistic infections
- Explore the molecular epidemiology of isolates to enrich our understanding of specific pathogens

Methods

Detailed descriptions of the methods utilised by the GERMS-SA surveillance programme are available.[1] In 2022, approximately 222 South African clinical microbiology laboratories participated in this surveillance programme. These diagnostic laboratory facilities are located in every province of the country and include the public, private, military, and mining sectors. 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. Diseases under surveillance in 2022 included: i) Opportunistic infections associated with HIV, e.g., *cryptococcosis*, rifampicin-susceptible *Mycobacterium tuberculosis,* and Nontyphoidal *Salmonella* species; ii) Epidemic-prone diseases, e.g., *Neisseria meningitidis*, *Salmonella enterica* serotype Typhi, *Salmonella enterica* serotype Paratyphi A, B and C, *Shigella* species, *Vibrio cholerae,* Diarrhoeagenic *Escherichia coli, Campylobacter* species, *Listeria* species, and *Streptococcus pyogenes*.; iii) Vaccine-preventable diseases, e.g., *Haemophilus influenzae* type b (Hib), *Streptococcus pneumoniae,* and *Streptococcus agalactiae;* and iv) Healthcare-associated bloodstream infections caused by Carbapenem resistant *Enterobacteriaceae* and *Enterococcus.*

Thirty enhanced surveillance sites, at least one in each province, were included in 2022. Sites were chosen for convenience, and all are within the public health sector. For eleven laboratory-confirmed diseases, surveillance officers completed clinical case report forms (CRFs) electronically using the

REDCap database on tablets at enhanced surveillance sites. These diseases included cryptococcosis, 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, and C, nontyphoidal diseases, Listeriosis, and rifampicin-susceptible TB (in seven provinces). The completion of the clinical case report forms (to obtain additional clinical details, including antimicrobial use, vaccination history, HIV status, and patient outcome) was by case-patient interview or hospital medical record review. Case-patient follow-up was 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 NICD Surveillance Data Warehouse (SDW) embedded in the NHLS Corporate Data Warehouse. For all diseases under surveillance, except cryptococcosis and rifampicin-susceptible TB, the audit design was 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 2021 and 2022 from Statistics South Africa.[2] The estimated population under surveillance in 2022 was 60,6 million.[2] Incidence in the HIV-infected and AIDS populations was calculated for 2021 and 2022 using the Thembisa model.[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.

Systems are in place to monitor data quality at each step of the surveillance process. Furthermore, data quality has constantly improved through training and auditing of the surveillance officers' data. The dissemination of analysed data nationally and internationally in various forms was done through an annual review, conference presentations, and publications in peer-reviewed journals. The principal investigators of the surveillance programme evaluate the focus and future direction of GERMS-SA surveillance annually.

Results & Discussion

GERMS-SA detected 12 995 surveillance cases in 2022. Excluding the cases of cryptococcosis (n=4 551, all of which were detected from the SDW), 5 817/8 444 (69%) of episodes had isolates sent by the clinical microbiology laboratories to the NICD for further characterisation, and only 31% (2 627/8 444) of cases were detected by audit of the NHLS SDW. At enhanced sites, 3 045/ 3 598 (85%) of cases had a CRF completed, of which 1 251 (41%) of the completed CRFs were by patient interview.

Opportunistic infections

Cryptococcosis: In 2022, the national incidence risk for cryptococcal meningitis or culture-confirmed cryptococcal disease was 60 per 100 000 HIV-infected persons, a decrease compared to 2021 (66 per 100 000 HIV-infected persons). This decline was most marked in KwaZulu-Natal Province (Table 1). The decrease in new cases may be due to individuals initiating ART earlier, or before they are at risk of opportunistic infections, or because of screening and pre-emptive treatment of patients with cryptococcal antigenaemia through the reflex CrAg programme. However, the total number of first episodes (4 551) and 270 recurrent episodes (among 226 patients) did not change substantially compared with 2021, and the burden on the healthcare system therefore persists. The vast majority (n=4 444, 98%) of incident cases were diagnosed as cryptococcal meningitis (laboratory tests on cerebrospinal fluid were positive for *Cryptococcus* species). Males aged 40 to 44 had the highest incidence risk in 2022, and the peak incidence among females was in the 35 to 39-year-old and 40 to 44-year-old age groups (Figure 1). There was a drop in the proportion of patients at enhanced surveillance sites (ESS) receiving flucytosine-based induction therapy, decreasing from 62% in 2021 (data not shown) to 52% in 2022. The in-hospital case-fatality ratio for patients at ESS with a first episode of cryptococcal disease was 38% (344/913) and was higher among individuals who did not receive flucytosine-containing induction regimen (46% [214/467]) compared to those who did (25% [101/398]). Updating of the South African standard cryptococcosis treatment guidelines was in mid-2022 and recommends 1 week of flucytosine and amphotericin B deoxycholate, followed by a week of high-dose fluconazole, as induction for cryptococcal meningitis. There is an urgent need for steps to enhance access to and promote the use of flucytosine. A remedy for the former is the inclusion of flucytosine in the national tender for Supply and Delivery of Anti-infective Medicines from October 2023.

Table 1. Numbers of cases and incidence of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA by province, South Africa, 2021-2022, n=9 490.

Province	2021		2022	
	n*	Incidence risk (95% CI)†	n*	Incidence risk (95% CI)†
Eastern Cape	828	101 (94-108)	728	88 (81-94)
Free State	171	45 (38-52)	177	47 (40-53)
Gauteng	1 016	52 (48-55)	1 026	51 (48-55)
KwaZulu-Natal	1 249	61 (58-65)	1 076	52 (49-56)
Limpopo	427	89 (81-97)	373	77 (69-85)
Mpumalanga	339	46 (41-51)	283	38 (33-42)
Northern Cape	47	56 (40-72)	52	61 (45-78)
North West	293	59 (52-66)	288	57 (51-64)
Western Cape	569	119 (109-129)	548	112 (103-122)
South Africa	**4 939**	**66 (64-68)**	**4 551**	**60 (58-62)**

*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[3] and is expressed as cases per 100 000 HIV-infected persons.

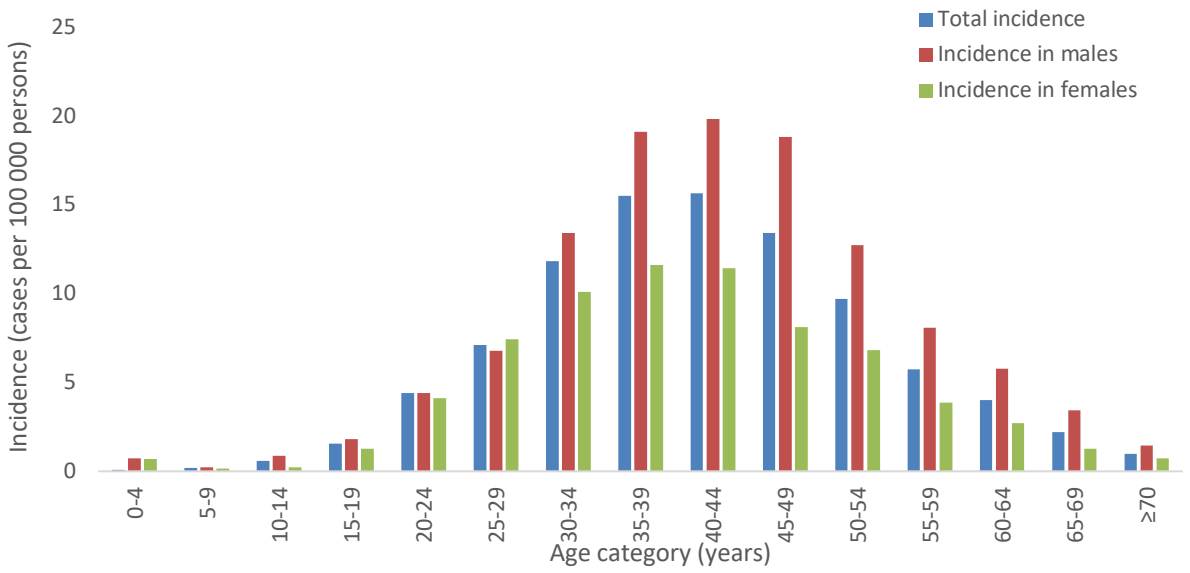

Figure 1. Numbers of cases and incidence of cryptococcal meningitis or culture-positive cryptococcal disease detected by GERMS-SA, by sex and age group, South Africa, 2022, n= 3 798.

Rifampicin-susceptible tuberculosis: Enrolment of participants with confirmed Rifampicin-susceptible TB was from seven provinces over a limited surveillance period. The majority of participants (250/371; 67%) had HIV co-infection, highlighting its continued importance in controlling the TB epidemic. Less than half of those who were HIV positive were already part of the ARV programme, but only 10 participants reported taking TB preventative therapy. More than half (58%) of the samples were from male participants. A large proportion of participants were unemployed (82%), an underappreciated factor that has an impact on health access. The overall prevalence of isoniazid mono resistance (13%) was higher than that reported in the national TB drug resistant survey of 2012-2014 (5-8%) and higher than the previous year (2021: 7.4%).[4] Unfortunately, the low number of samples received during the previous two surveillance years (within the COVID pandemic) does not allow for a robust analysis of resistance rates or a robust comparison to previous years. The high smear positivity, 65% (244/371) of sputum samples, was concerning as this is indicative of transmission of isoniazid mono resistance.

Nontyphoidal salmonellosis (NTS) is usually foodborne and typically manifests as acute gastroenteritis. Invasive disease is usually associated with HIV infection or the presence of other risk factors. More NTS cases were reported in 2022 (n=3 185) than in 2021 (n = 2 445) or 2020 (n = 2 306). As in previous years, although seasonal prevalence was noted for non-invasive disease (increased numbers in the warmer months and low numbers in the winter months), invasive disease showed no seasonality. Greater numbers of invasive diseases 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 reports of invasive disease were more common in adults aged 35 to 44 years than in previous years. *Salmonella* Enteritidis was the predominant serovar, followed by *Salmonella* Typhimurium, a pattern observed since 2012.

Vaccine-preventable diseases

The 2022 data continue to indicate decreasing trends in invasive pneumococcal disease (IPD) and *Haemophilus influenzae* (HI) post the 2009 expanded programme on immunisation (EPI) introduction of pneumococcal conjugate vaccine (PCV7/13) and the *Haemophilus influenzae* type B (Hib) booster vaccine.

Invasive *Haemophilus influenzae*: Invasive HI disease incidence (0.58 per 100 000 population) in 2022 returned to pre-COVID-19 pandemic levels in South Africa. Most cases occurred in infants <1 year, and non-typeable disease dominated in almost all age categories (Figure 2). Eight percent (12/156) of HI cases were non-susceptible to ampicillin. Case-fatality was high (24%, 33/140) for all episodes of HI infection at enhanced surveillance sites (ESS), and 18% of meningitis survivors suffered long-term sequelae. Over half of people with HI disease had some predisposing condition. Hib disease continued to decline in children <1 year old, even though almost a third of children with Hib disease had missed all their age-eligible doses of Hib vaccine and over 40% had skipped at least one dose.

Primary Hib vaccination and booster doses are important in preventing invasive Hib in the community, particularly among premature infants.

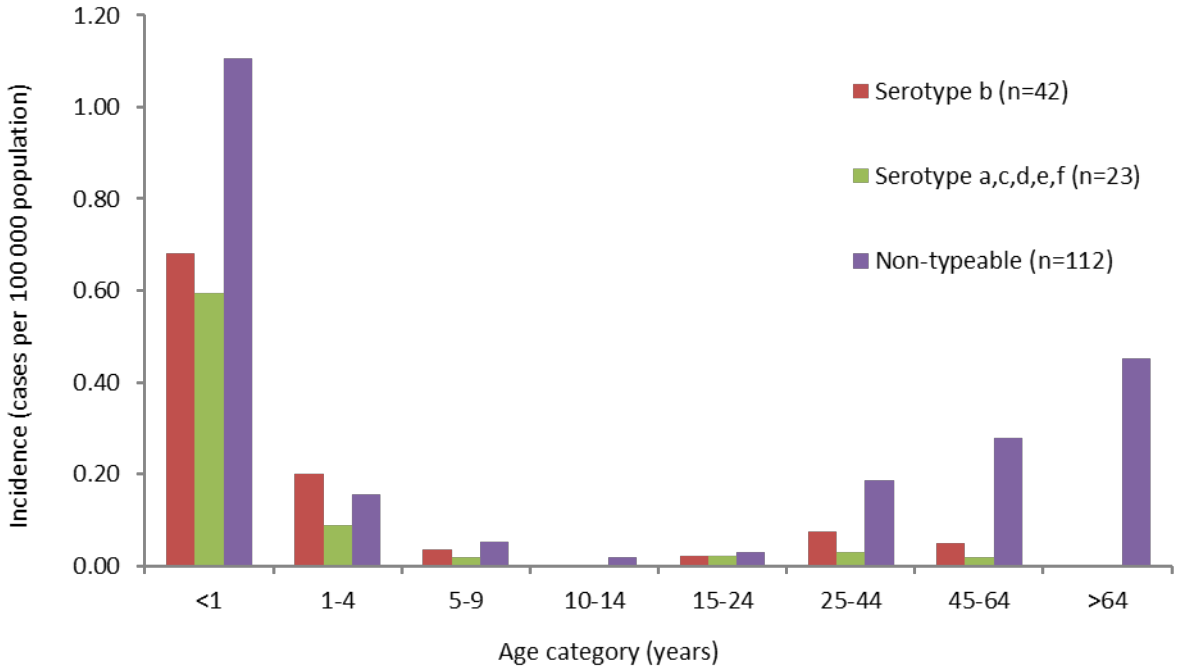

Figure 2. Age-specific incidence rates* for laboratory-confirmed, invasive *Haemophilus Influenzae* disease, reported to GERMS-SA, South Africa, by serotype in 2022, n=349 (age unknown n=14; isolates unavailable for serotyping n=172).
*Incidence rates were calculated based on population denominators provided by Statistics South Africa and are expressed as cases per 100 000 population.

Invasive *Streptococcus pneumoniae:* The incidence of IPD (invasive pneumococcal disease) caused by *Streptococcus pneumoniae* has increased year-on-year since 2020 in almost all age categories but has not yet returned to pre-COVID-19 levels (Table 2). The incidence in the Western Cape Province was three times higher than the national incidence, warranting further investigation. Infants continue to show the highest IPD incidence, followed by adults 25 years and older, potentially driven by the high rate of comorbidities (including HIV infection and previous tuberculosis infections) in the adult population. In-hospital case-fatality was 33% (217/655) and increased to 54% (27/50) among those >64 years. Penicillin non-susceptibility was demonstrated in 35% (398/1 144) of all cultured isolates. In both children and adults, serotypes 8 and 3 dominated, with 19F and 19A also featuring in the top three places, respectively (Table 3). A third of all serotyped IPD episodes in South Africa were due to serotypes in PCV13, ranging from 19% in infants to 43% in 5- to 9-year-olds, and there were reports of many breakthrough infections in fully vaccinated children. Ongoing IPD surveillance in South Africa will be important as the country moves forward with changes in pneumococcal conjugate vaccine formulations in the expanded programme on immunisation.

Table 2. Numbers of cases and incidence rates of invasive pneumococcal disease reported to GERMS-SA by province, South Africa, 2019-2022, n=7 002 (including audit cases).

Province	2019		2020		2021		2022	
	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*	n	Incidence rate*
Eastern Cape	274	4.08	136	2.02	201	3.01	224	3.35
Free State	83	2.91	62	2.12	70	2.39	62	2.12
Gauteng	774	5.11	377	2.43	465	2.94	515	3.20
KwaZulu-Natal	237	2.10	99	0.86	116	1.01	158	1.37
Limpopo	96	1.62	52	0.89	45	0.76	69	1.16
Mpumalanga	102	2.22	41	0.88	56	1.18	53	1.12
Northern Cape	89	7.12	26	2.01	25	1.92	27	2.06
North West	66	1.64	36	0.88	32	0.78	48	1.15
Western Cape	631	9.25	413	5.90	539	7.58	703	9.75
South Africa	**2 352**	**4.01**	**1 242**	**2.08**	**1 549**	**2.58**	**1 859**	**3.07**

*Incidence rates were calculated based on population denominators provided by Statistics South Africa and are expressed as cases per 100 000 population.

Table 3. Numbers and proportions 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, 2022, n=1 859 (n=1 144 with viable isolates).

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 serotypes	
		n	%	n	%	n	%	n	%	n	%	n	%
<1	71	7	10	8	11	15	21	15	21	31	44	36	51
1-4	72	18	25	11	15	25	35	25	35	33	46	35	49
5-9	14	7	50	3	21	7	50	7	50	9	64	9	64
10-14	11	2	18	2	18	2	18	3	27	6	55	7	64
15-24	56	4	7	6	11	13	23	14	25	32	57	37	66
25-44	471	84	18	73	16	159	34	174	37	280	59	325	69
45-64	328	67	20	45	14	122	37	133	41	213	65	236	72
>64	106	13	12	13	12	34	32	42	40	62	58	76	72
unk	15	1	7	3	20	3	20	3	20	8	53	8	53
		203	18	**164**	14	**380**	33	**416**	36	**674**	59	**769**	67

Serotypes included in each of the pneumococcal conjugate 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 licensed for use in South Africa*

Invasive *Streptococcus agalactiae*: Nationally, incidence for invasive Group B Streptococcus (*Streptococcus agalactiae*) disease fluctuated through the COVID-19 pandemic years but has since stabilised at rates slightly higher than in 2019. In 2022, infants had by far the highest incidence of invasive group B strep disease (54 per 100 000 persons) - 75 times higher than in persons ≥1 year of age. However, amongst those ≥1 year, the highest incidence occurred in those aged 25 to 44 years (0.7 per 100 000 persons) (Figures 3a and 3b). Incidence per 1 000 live births in 2022 was 0.29 for early onset (<7 days of life) and 0.20 for late onset (7-90 days) invasive group B strep disease. The number of laboratory-confirmed episodes varied by province, with Gauteng, KwaZulu-Natal, and Western Cape provinces reporting the highest numbers. This may reflect under-ascertainment of cases in less populated provinces through lower rates of blood cultures performed, particularly amongst

hospitalised neonates. Overall, 18% (76/412) of patients with outcome data died, including 37 deaths amongst 171 neonates (22%). The extremely poor pregnancy outcome amongst women with laboratory-confirmed intrauterine sepsis (88% (80/95) resulted in death of the neonate/foetus) highlights the large role that group B strep plays as a cause of stillbirth and spontaneous abortion. Serotypes III and Ia were dominant across all age categories and specimen types. The majority of isolates were susceptible to penicillin, which is still the first-line antimicrobial agent for targeting neonatal sepsis.

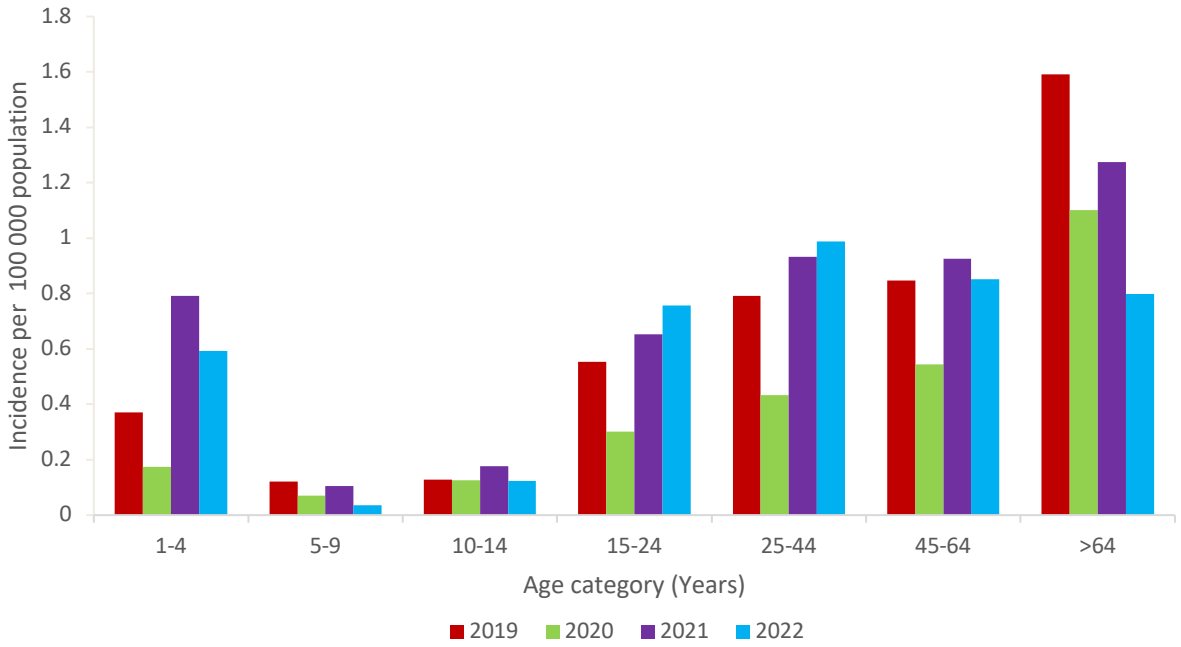

Figure 3a. Incidence of laboratory-confirmed invasive Group B Streptococcus by age (≥12 months) and year reported to GERMS-SA, South Africa, 2019-2022 (N=4 052, n=174 with unknown age, and n=2 417 <12 months).

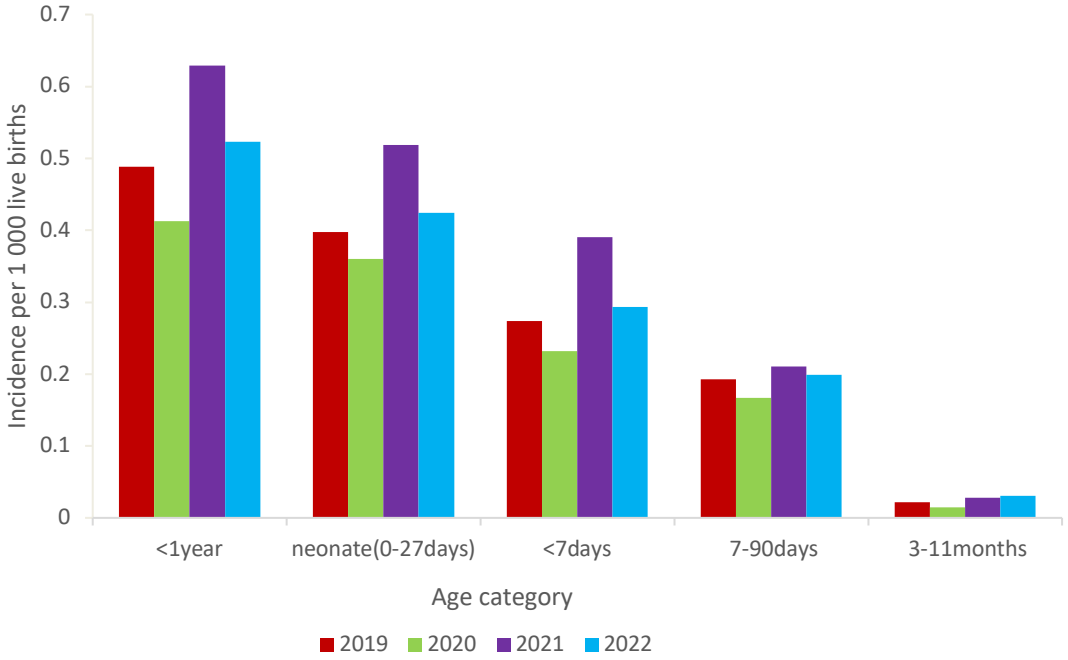

Figure 3b. Incidence of invasive Group B Streptococcus per 1 000 live births per age category (<12 months) and year reported to GERMS-SA, South Africa, 2019-2022 (N=2 417).

Epidemic-prone diseases (Notifiable medical conditions)

Invasive *Neisseria meningitidis*: The incidence of invasive meningococcal disease (caused by *Neisseria meningitidis)* in 2022 (0.12 per 100 000 population) was double that in 2021 (0.05 per 100 000 population), but it had not yet reached the 2019 incidence rate (0.19 per 100 000 population, pre-COVID-19 pandemic). The highest incidence was reported in infants <1 year of age, followed by children 1 to 4 years of age (Figure 4). There were no reports of clusters during 2022, and most episodes occurred in the winter and spring months. Although many episodes did not have a serogroup reported, incidence of all circulating serogroups increased from 2021 to 2022, with serogroups B, W, and Y occurring in equal numbers in the Western Cape Province (the province with the highest burden of disease) (Table 4). Just over half the isolates (16/29, 55%) were penicillin non-susceptible, and these (including two ciprofloxacin-resistant isolates) will be sequenced for further analysis. In-hospital case-fatality was 12% (2/17) and a third of those surviving to discharge developed long-term sequelae.

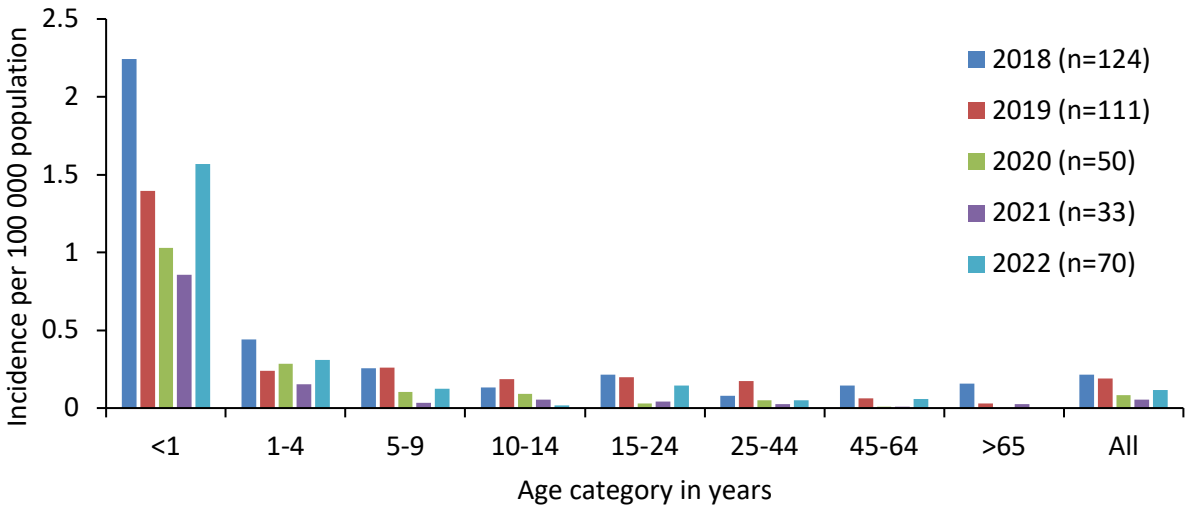

Figure 4. Incidence of invasive meningococcal disease by age-category, South Africa, 2018-2022 (n=388).

Table 4. Numbers of cases of invasive meningococcal disease reported to GERMS-SA by serogroup and province, South Africa, 2022, n=70*.

Province	Serogroup								
	Serogroup not available	A	B	C	W	Y	Z	E	Total
Eastern Cape	1	0	3	0	1	0	0	0	5
Free State	1	0	1	0	1	0	0	0	3
Gauteng	16	0	0	0	3	4	0	0	23
KwaZulu-Natal	2	0	3	1	0	0	0	0	6
Limpopo	0	0	0	0	0	3	0	0	3
Mpumalanga	1	0	1	0	0	0	0	0	2
Northern Cape	0	0	1	0	0	0	0	0	1
North West	0	0	0	1	0	1	0	0	2
Western Cape	6	0	6	1	6	6	0	0	25
South Africa	**27**	**0**	**15**	**3**	**11**	**14**	**0**	**0**	**70**

*43 (61%) with viable isolates or specimens available for serogrouping/genogrouping; there were no non-groupable meningococcal isolates causing invasive disease in 2022.

***Salmonellla enterica* serovar Typhi:** Enteric fever caused by *Salmonella* Typhi remains endemic in South Africa. Reported cases in 2022 were the highest since 2006, with half the cases reported from Gauteng Province (51%, 104/204). The number of cases was highest in children aged 5 to 14 years (29%, 60/204), followed by 15 to 24-year-olds (18%, 37/204), and adults aged 25 to 34 years (18%, 37/204). The cause of the increase in the number of cases in Gauteng Province was small, localised clusters (outbreaks) as defined by the genetic relatedness of isolates on core-genome multilocus sequence typing analysis of whole genome sequence data. Identification of cases from an outbreak strain originating in North West Province was in other provinces, including Gauteng Province. Ninety percent of isolates (161/178) were susceptible to ciprofloxacin (higher than in previous years), and 99% (176/178) were susceptible to azithromycin following CLSI breakpoints.[5] Cases of enteric fever caused by *Salmonella enterica* serovars Paratyphi A, Paratyphi B, or Paratyphi C remained uncommon in South Africa, with only 3 cases of *Salmonella* Paratyphi A reported in 2022. Reported cases significantly underrepresent the true number of cases, and the number of cases reported from different provinces may reflect healthcare-seeking behaviour and prevailing clinician testing practices.

***Shigella* species infections:** Children younger than five years continued 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. Larger case numbers were reported in 2022 (n = 948) than in 2020 (n=698) and 2021 (n=514). *Shigella flexneri* type 2a, *S. sonnei,* and *S. flexneri* type 1b were the predominant serotypes, in keeping with previous years.

***Listeria monocytogenes* infections:** The number of listeriosis cases for 2022 (88) was below the expected range of annual cases (119-298) based on the estimated incidence of sporadic cases (2-5 cases per million population per year). As in previous years, most cases were reported from the Western Cape (33 cases), Gauteng (20 cases), and KwaZulu-Natal provinces (17 cases), with a lower percentage of cases reported from Gauteng Province in 2022 compared with 2020 and 2021. In contrast to previous years, more cases were reported in the 15 to 49-year-old age group (35/88, 40%) than in neonates ≤28 days (24/88, 27%) in 2022.

***Vibrio cholerae* infections:** In 2022, reports and confirmations of four cases of cholera were nontoxigenic non-O1, non-O139 *V. cholerae*. These cases did not meet the case definition for cholera and did not therefore warrant a public health response.

***Campylobacter* species infections:** There were only reports of campylobacteriosis cases for which there were isolates from diagnostic laboratories. There were no audits, so cases for which there were no isolates are not included in the report. Eight-eight percent (710/804) of *Campylobacter* spp. isolates submitted through the surveillance programme in 2022 were from diagnostic laboratories in the private sector. Under-reporting due to audits not being performed and 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 likely contributing factors for the numbers of isolates received from public and private laboratories, respectively. For most cases (98%, 788/804), the isolate was recovered from stool or rectal swab samples reflecting non-invasive diarrhoeal disease. Case numbers were highest in children younger than five years (244/804, 30%) and appeared higher in the warmer months.

Invasive group A streptococcus: Invasive group A strep infections were defined as *Streptococcus pyogenes* isolates from a normally sterile site specimen or from a non-sterile site with an accompanying diagnosis of septic shock, necrotising fasciitis, or necrotic tissue. Invasive group A strep mostly affected infants (incidence of 5.5 per 100 000 persons), followed by adults >64 years (2.4 per 100 000 persons), with the majority of infections diagnosed through blood culture (582/947). The organism likely originated from a breech to the skin through recent surgery or trauma. Although the majority of isolates were susceptible to first-line antimicrobial agents, penicillin and erythromycin, the in-hospital mortality was high (26%, 103/402).

Limitations

Laboratory-based surveillance is heavily reliant on health-seeking behaviour of patients and specimen-taking practices of clinicians, neither of which are controlled. Estimates of disease incidence are minimum estimates, and some cases may be missed, especially in the private sector, where audits for missing isolates are not performed. Work pressures and supply chain challenges at public laboratories have a negative impact on the number of isolates received by NICD reference laboratories, especially in terms of the number of isolates received, isolate viability, and specimens processed. If an isolate is not sent to the NICD, no antimicrobial susceptibility testing or serotyping/serogrouping information is available on these missing/non-viable isolates. The enhanced surveillance sites were chosen for convenience and are not necessarily representative of all surveillance sites in South Africa. Unfortunately, poor record systems in many of the public hospitals hinder the collection of clinical information at enhanced surveillance sites.

Conclusion

The GERMS-SA surveillance detected 12 995 cases in 2022. These showed varying trends in incidence by pathogen and age group, highlighting the value of the GERMS surveillance system in terms of monitoring the impact of pathogen-specific programmes. GERMS-SA therefore continues to provide accurate, quality-controlled strategic information for patient management and public health policymakers, influencing health practice planning, implementation, and evaluation for the infections under surveillance.

Recommendations

- All clinical microbiology laboratories are encouraged to continue to submit isolates for surveillance.
- The National Department of Health and other stakeholders are encouraged to continue to promote prevention, testing and treatment for HIV.
- The National Department of Health should enhance access to and promote the use of flucytosine.
- The National Department of Health and other stakeholders are encouraged to promote the use of TB preventative therapy.
- Clinicians and nurses should continue to promote vaccination as per EPI and to achieve high coverage of all doses.
- GERMS-SA and its laboratory and clinical partners need to continue active surveillance of laboratory-confirmed infections to monitor for serotype changes of vaccine-preventable diseases and changing patterns of antimicrobial resistance in the organisms under surveillance.
- Group B strep surveillance highlighted the large role that this organism plays regarding neonatal sepsis and intrauterine sepsis in women; therefore, the National Advisory Group for Immunisations should investigate new group B strep vaccines for prevention of stillbirths, spontaneous abortions, preterm births, and neonatal sepsis as and when they become available.
- Clinicians should consider the diagnosis of invasive meningococcal disease in any person presenting with fever and/or headache with rapid clinical deterioration and initiate appropriate treatment immediately, and the public health community should be mindful of the current changing pattern of IMD serogroups regarding its epidemic potential.
- The National Department of Health should continue to engage with the Department of Water and Sanitation to promote the provision of safe water and improved sanitation to prevent gastrointestinal water-borne diseases.
- Clinicians should engage with the online notifiable medical conditions platform and file necessary reports as required.

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Ethics

Ethics approval for the surveillance programme: Human Research Ethics Committee (Medical), University of Witwatersrand (clearance number M1809107), and from relevant university and provincial ethics committees for other enhanced surveillance sites.

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Conflicts of interest

The authors declare no conflicts of interest.

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For more information, please visit the full GERMS-SA 2022 report at https://www.nicd.ac.za/wp-content/uploads/2024/02/NICD-GERMS-Annual-Report-2022.pdf.