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Protect our future leaders: Advocating for meningococcal vaccination to prevent meningococcal disease amongst tertiary students in South Africa

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Summary

Meningococcal disease is a devastating illness that affects healthy young individuals, many of whom are tertiary students. It can result in sudden death or long-term sequelae such as blindness, deafness, or amputations. Newly acquired meningococcal nasopharyngeal colonisation occurs frequently on tertiary campuses through close contact with others and may result in serious illness. Barely a year passes in South Africa without a report of a student found dead in their university residence showing signs of meningococcal disease. This policy brief explores how tertiary students can be informed of their risk of meningococcal disease and offered vaccination to prevent meningococcal colonisation, disease, death, or lifelong disability.

Problem statement

Young adults aged 15–24 years have the second highest burden of meningococcal disease in South Africa (SA), similar to other middle- and high-income countries.[1] Although a relatively rare disease, one in 10 persons who develop meningococcal disease will die, and one in five will develop long-term sequelae, as seen globally.[2,3]

First-year university students have an increased risk of meningococcal disease in comparison to the general population, probably reflecting higher carriage acquisition and prevalence driven by behavioural factors and exposure to new strains from varied geographic origins.[4,5] Sporadic cases and small clusters of invasive meningococcal disease often occur among students living in shared accommodation.[6] As a notifiable epidemic-prone disease, each occurrence requires an immediate public health response in the form of contact tracing and the provision of chemoprophylaxis with or without preventative vaccination campaigns to prevent further spread on campus and in the community.[7]

Local situation

Currently, SA is amongst the top 15 African countries with a high burden of meningitis, even though it does not experience meningococcal epidemics as do other countries in the African meningitis belt. As in many other high- and middle-income countries, meningococcal disease incidence in SA has been steadily climbing since 2022 following a dip during the COVID-19 pandemic years (Figure 1).[1,8]

In the Western Cape province, the young adult population (15–24 years of age) had the second highest meningococcal disease incidence at one episode per 100 000 persons in 2023. Based on this incidence rate and the relative risk of disease in tertiary students, the estimated incidence of meningococcal disease in tertiary institutions ranges from 1.4 episodes per 100 000 in first-year students to 3.7 episodes per 100 000 first-year students residing in institutional residences.[4,9] In 2023, the case-fatality ratio following meningococcal disease in SA was 17%, with approximately 20% of

survivors developing long-term disabilities.[1] Most deaths occurred within one day of hospital admission, highlighting the importance of disease prevention. Serogroup B was the most dominant disease-causing serogroup, while 45% of episodes were due to a combination of serogroups C, W, and Y (Figure 1). Serogroups A, X, and Z (other disease-causing serogroups) have not been detected in the past few years.

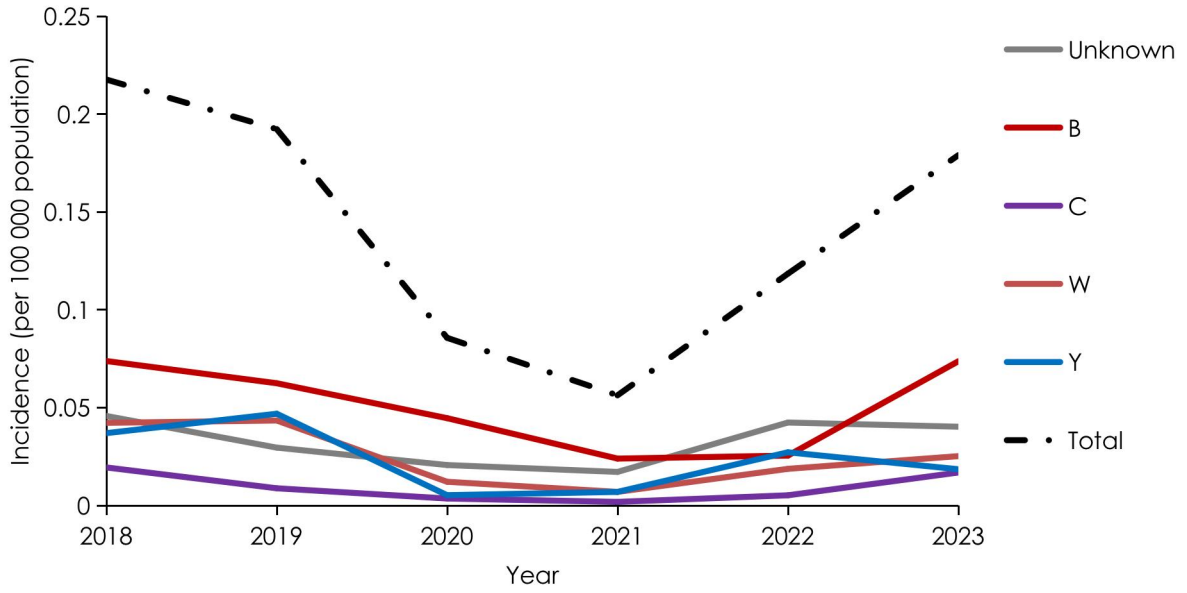

Figure 1. Incidence of invasive meningococcal disease by serogroup and year, South Africa, 2018-2023.[1]

Meningococcal carriage rates amongst the South African population are unknown. However, a study in 2017 showed a meningococcal carriage rate of 8% among tertiary students, with males 1.5 times more likely to carry meningococcus than females.[10] This study also showed a 200% increase in meningococcal carriage amongst first-year university students during registration week.

Primary cause and main modifiable root causes

New acquisition of nasopharyngeal carriage with a virulent meningococcal strain is the predisposing step to developing invasive meningococcal disease. *Neisseria meningitidis*, the bacterial organism responsible for causing meningococcal disease, asymptomatically colonises the back of the human nasopharynx and is spread from person to person through respiratory droplets. Approximately one in 10 persons may carry meningococcus; however, teenagers and young adults typically have the highest carriage rate, with one study from university students in the United Kingdom (UK) showing a carriage rate of 30%.[5] The meningococcus mostly resides in the nasopharynx without causing disease. Occasionally, however, virulent strains invade the nasal mucosa, enter the bloodstream, and cause severe meningococcal disease in the form of septicaemia or meningitis.

Meningococcal vaccination against the meningococcal serogroups causing invasive disease is effective in preventing disease. In addition, the polysaccharide conjugate vaccines may prevent colonisation, decreasing the chance of respiratory droplet spread.[11] Due to the rapid onset and quick deterioration of persons developing meningococcal disease, vaccination is the primary prevention measure. In SA, meningococcal vaccination is not part of the national immunisation programme and even though vaccines are available in the private sector, less than 1% of the population has received a dose of the meningococcal vaccine. Five serogroups cause most of the meningococcal disease in SA, requiring two different vaccines to cover all prevalent serogroups, i.e., the recently launched serogroup B vaccine and the quadrivalent (ACWY) or pentavalent (ACWYX) conjugate vaccine. Many factors contribute to the low vaccine uptake, including the high price of the vaccines (approximately R1 500/dose), the requirement of a doctor's prescription due to the South African Health Products Regulatory Authority scheduling of the vaccine product, and the lack of awareness of disease risk from meningococcus, particularly amongst young adults.

As meningococcal colonisation/carriage is a prerequisite for meningococcal disease, preventing person-to-person transmission of infected respiratory droplets will reduce acquisition and colonisation of *N. meningitidis*, thus reducing the risk of disease. Various behavioural factors have been associated with increased risk of meningococcal transmission and carriage acquisition in young adults, and tertiary students in particular. These include living in shared accommodation (residences), frequent attendance at nightclubs/pubs, exposure to primary and secondary smoke, having multiple intimate kissing partners, and the mixing of multiple people from varied geographical regions.[5,10]

Some underlying medical conditions predispose persons to meningococcal carriage and thus disease, including HIV infection, asplenia, complement deficiency, and other immunocompromising conditions.[12]

In summary, invasive meningococcal disease is a devastating illness with a high mortality and a high rate of long-term complications in survivors. Sporadic cases in young adults attending university are not uncommon. New acquisition of nasopharyngeal carriage through exposure to respiratory droplets containing a virulent meningococcal strain is the predisposing step to developing invasive meningococcal disease. Lack of awareness of one's perceived risk of acquiring meningococcal carriage or disease, the severity of the illness, and lack of awareness of prevention measures may contribute to the spread of this distressing illness (Table 1).

Table 1. Root cause analysis to the problem of meningococcal disease and carriage amongst tertiary students in South Africa.

Possible root cause	Meningococcal disease and carriage			
	Effect on transmission/ carriage	Effect on disease risk	Modifiable	Impact
Behavioural factors: Living in shared-accommodation (residences), exposure to smoke, attendance at pubs/clubs, multiple intimate kissing partners, interacting with multiple people from various geographical regions	Yes	No	Partially	Medium
Underlying medical conditions: HIV infection, asplenia, complement deficiency, immunocompromising conditions	Yes	Yes	Not easily	Low to medium
Low vaccine uptake: Unaware of vaccine availability, difficulty accessing vaccine without a doctor's prescription, high price of current quadrivalent (ACWY) vaccine and serogroup B vaccine, unavailability of low-cost pentavalent (ACWYX) vaccine	Yes	Yes	Totally	Medium to high
Lack of disease awareness: Unaware of threat to students, unaware of signs and symptoms, unaware of severity of illness, unaware of risk factors for carriage	Yes	Yes	Totally	Low to medium

Policy options

To minimise meningococcal disease-related deaths and complications among tertiary students, it is crucial to focus on both meningococcal carriage and disease. This can be done through increasing awareness of the risk of meningococcal disease amongst the students and by providing meningococcal vaccination for the students. Three options for implementation are described, along with the status quo.

Status quo

No meningococcal vaccine is currently being offered to tertiary students, and students remain unaware of their risk of carriage acquisition or disease. Reactive public health response and containment measures are implemented following an episode of meningococcal disease. Approximately 200 000 first-year students begin their tertiary education journey in SA each year, with extremely few having received any vaccination against meningococcus. Currently, only one tertiary institution requires foreign students to be vaccinated against meningococcal disease and recommends vaccination for all other students. The same university partially subsidises the meningococcal vaccine (quadrivalent conjugate vaccine against serogroups A, C, W, and Y).

All meningococcal disease episodes require hospitalisation (many in an intensive care unit) and at least seven days of intravenous antibiotics, unless death occurs. Post-hospitalisation, at least one in five survivors require lifelong care for complications of the disease. All episodes require active contact tracing to identify close contacts and provision of chemoprophylaxis to these contacts within 48 hours or up to 10 days after contact with the index case. All close contacts need to be monitored for the onset of meningococcal disease symptoms to ensure early detection of subsequent episodes. Any subsequent meningococcal disease episode of the same serogroup (i.e., A, B, C, W, X, or Y) in someone affiliated with the institution within three months of the index case warrants an outbreak investigation.[7]

Option 1

Implement an on-campus education campaign to improve awareness of meningococcal disease and prevention and promote meningococcal vaccine uptake.

Knowledge of meningococcal disease risk and prevention measures would improve meningococcal disease awareness and vaccination uptake amongst students.[7,8]

A UK study on teenagers' knowledge of vaccines and invasive meningococcal disease showed that students with above-average knowledge of vaccines and invasive meningococcal disease were more likely to be vaccinated (OR=3.057, p=0.019). Vaccination views were positive, and their knowledge level was moderate to high.[13] Quadrivalent (ACWY) vaccine uptake was 84%, with socioeconomically disadvantaged students being less likely to be vaccinated (aOR=0.117, p=0.006). On-campus education campaigns on meningococcal disease risk, symptoms, and signs will create awareness around meningococcal disease and its consequences and the use of the meningococcal vaccine that can save lives and prevent disabilities.

The education campaign can include emails sent out to students and parents at the time of institutional acceptance, outlining the risk and need for the meningococcal vaccine. The same message can be repeated via on-campus radio messaging, posters, and banners displayed around campus. Education campaigns utilising multimedia and pre-existing content from meningococcal/meningitis awareness organisations (such as CoMO, https://www.comomeningitis.org/) require minimal financial resources and can be expected to increase vaccine uptake by approximately 10%.[13]

Option 2

Vaccinate ALL first-year tertiary students against meningococcal disease during the first month of registration.

The meningococcal vaccine is not currently part of the South African expanded programme on immunisation (EPI) schedule or school-based programme; therefore, few students would have protection when attending tertiary institutions, putting them at high risk of acquiring meningococcal carriage and disease. In England and Wales, a monovalent (serogroup C) meningococcal vaccine was introduced into their National Immunisation Programme and school-based programme in 1999, and meningococcal disease from serogroup C decreased from 883 cases in 1999 to 389 cases in 2001 and to 28 cases in 2015.[6] Meningococcal vaccination can therefore decrease meningococcal carriage, disease, deaths, and disabilities amongst all vaccinated students.

The South African government has pledged a commitment to defeating meningitis by 2030; therefore, it would be preferable for the national government (Department of Health (DoH) and Department of Higher Education and Training (DHET)) to subsidise the cost of meningococcal vaccines for all on-site first-year students at the time of university registration.

The feasibility of this policy option is medium-to-high. Meningococcal vaccination campaigns during registration month could be easily implemented using campus health clinic staff; however, the costs of the currently available vaccines are high, and the apparent rarity of this severe disease does not completely offset the initial investment (see cost analysis below). The quadrivalent (ACWY) vaccine requires one dose, and the monovalent serogroup B vaccine requires two doses. An equivalently efficacious, more affordable pentavalent (ACWYX) meningococcal vaccine being registered in SA by Serum Institute India, requiring one dose, could bring down the vaccination cost substantially when compared to the quadrivalent vaccine. Any meningococcal vaccine would provide at least five years of protection, thereby sustaining protection through the students' university stay.

Introducing meningococcal vaccination should ideally be accompanied by a strong meningococcal vaccination awareness campaign (option 1), to avoid the low vaccine uptake (25–40%) experienced by some countries that only offer vaccination.[13]

Option 3

Vaccinate only first-year students staying in institutional residences within the first month following registration.

Students living in institutional residences have a higher acquisition of meningococcal carriage from multiple opportunities of coming into close contact with other individuals. In addition, students living in residences have a 3.5 times increased risk of developing meningococcal disease than their age-related counterparts in the general population.[9] The meningococcal vaccine will decrease carriage and disease incidence, deaths, and sequelae amongst these high-risk students. This is a smaller,

defined group of high-risk students; therefore, vaccination costs would be greatly reduced.
As part of the government's commitment to defeat meningitis by 2030, it would be appropriate for DoH and DHET to subsidise the cost of meningococcal vaccines for first-year students in institutional residences.

The feasibility of this option is again medium to high. Vaccination of this well-defined high-risk group will be more easily implementable through the campus health clinic service. However, vaccine costs remain high but are reduced due to fewer vaccines being required for the selected population living in institutional residences. Once again, this policy option should be combined with an education campaign (option 1) to ensure high vaccine uptake and increase awareness of this serious disease.

Economics of the policy options

We conducted a decision analysis, including a cost analysis and a cost-effectiveness analysis, to determine which option would be most effective and affordable at preventing meningococcal disease and deaths. The parameters included in the model are listed in Table 2. The cost analysis was from a government perspective and took into account the cost of illness (including hospital stay and lifetime medical costs in individuals developing sequelae), contact tracing following an episode, vaccine and vaccine delivery costs, and costs of implementing an education campaign with a discount rate of 5%. The analytic horizon for prevention of meningococcal disease expanded over the four years a student may be expected to take to complete their studies, while long-term consequences of meningococcal disease were considered and discounted over a lifetime horizon.

Three meningococcal vaccine options were considered in the economic analysis: using the pentavalent conjugate vaccine (ACWYX) [not yet available in SA]; using the quadrivalent conjugate vaccine (ACWY) [currently available in the public and private healthcare sectors]; or using a combination of the quadrivalent (ACWY) and the monovalent serogroup B vaccine [available only in the private sector] for comprehensive serogroup coverage.

Table 2. Parameters for determining costs and a cost-effectiveness analysis of various policy options to reduce invasive meningococcal disease (IMD), deaths, and disabilities in tertiary students in South Africa.

Parameters used in decision analysis	Costs of illness (ZAR)	Reference
Bacteraemic IMD who survived without sequelae	R56 177	
Bacteraemic IMD who developed sequelae	R166 542	
Bacteraemic IMD who died	R35 459	
Meningitis IMD who survived without sequelae	R25 830	GERMS-SA Annual Review 2023[1] ; hst.org.za
Meningitis IMD who developed sequelae	R136 196	
Meningitis IMD who died	R32 430	
Cost of meningococcal post-exposure follow-up per case	R26 732	
Vaccine administration cost per student	R101	Fraser, 2022[14]
Vaccine cost per student		
Quadrivalent ACWY conjugate vaccine	R500	www.health.gov.za
Pentavalent ACWYX conjugate vaccine	R60	www.gavi.org
Monovalent serogroup B vaccine (2 doses at R1500ea)	R3 000	
	Other parameters	**References**
Annual incidence of meningococcal disease in 15–24yr (2023) in Western Cape	1.019 per 100 000	GERMS-SA Annual Review 2023[1]
Annual incidence of IMD in college/university students (estimated)	1.498 per 100 000	DeRoo, 2021[4]
Annual incidence of IMD in first-year students (estimated)	1.386 per 100 000	Bruce, 2001[9]
Incidence of IMD in first-year students in residences (estimated)	3.712 per 100 000	Bruce, 2001[9]
Number of first-year students	208 299	sanews.gov.za
Number of first-year students in residences	55 750	sanews.gov.za
Projected life expectancy for an 18-year-old in South Africa	49.9 yrs	www.statssa.gov.za
Disability adjustment factor for having meningococcal disease	0.05	Watle, 2021[15]
Disability adjustment factor for having sequelae	0.27	De Necker, 2019[16]
Meningococcal conjugate vaccine effectiveness	0.80 - 0.85	Cohn, 2017[17]; Langevin, 2025[18]
Meningococcal vaccine uptake in first-year students	0.6	Bruce, 2001[9]
Meningococcal vaccine uptake in first-year students in residences	0.8	DeRoo, 2021[4]
Meningococcal vaccine uptake in conjunction with awareness campaign	+0.1	Jones, 2020[13]
Proportion of meningococcal disease episodes due to serogroups in the vaccine (serogroups A, C, W, and Y)	0.61	GERMS-SA, 2019[19]
Proportion with meningococcal disease who died	0.19	GERMS-SA, 2019[19]
Proportion alive with sequelae	0.162	Meiring, 2022[20]
Proportion alive without sequelae	0.648	Meiring, 2022[20]

A decision tree, made in the Amua 0.3.1 open-source modelling framework (https://github.com/zward/Amua/), was used for the cost-effectiveness analysis of the various policy options. The costs of illness, discounted programme costs, disability-adjusted life-years (DALY) averted, and incremental cost-effectiveness ratios per DALY averted are displayed for each policy option in Table 3.

Table 3. Cost-effectiveness analysis of various policy options to reduce meningococcal disease, deaths, and disabilities in tertiary students, South Africa.

	Status quo: No vaccine	Option 2: Vaccinate all first-year students	Option 3: Vaccinate all first-year students in residences	Options 1&2: Education campaign and vaccine for all first-years	Options 1&3: Education campaign and vaccine for first-years in residences
Cost of illness per year	R250				
- using pentavalent vaccine	200 -	R176 200	R108 600	R163 900	R99 800
- using quadrivalent vaccine	-	R176 200	R108 600	R163 900	R99 800
- using quadrivalent plus serogroup B vaccine	-	R127 200	R61 800	R80 100	R40 300
Savings on cost of illness per year					
- using pentavalent vaccine	-	R74 000	R141 600	R86 300	R150 400
- using quadrivalent vaccine	-	R74 000	R141 600	R86 300	R150 400
- using quadrivalent plus serogroup B vaccine	-	R122 800	R188 400	R170 100	R209 900
Cost of programme/year					
- using pentavalent vaccine	-	R19 777 700	R6 866 800	R21 734 200	R7 545, 00
- using quadrivalent vaccine	-	R74 768 700	R26 490 800	R82 224 300	R29 132 300
- using quadrivalent plus serogroup B vaccine	-	R462 093 700	R164 584 700	R508 153 000	R181 001 300
DALY's averted					
- using pentavalent vaccine	-	55	53	64	59
- using quadrivalent vaccine	-	55	53	64	59
- using quadrivalent plus serogroup B vaccine	-	92	88	108	99
ICER per DALY averted					
- using pentavalent vaccine	-	R358 100	R130 100	R337 300	R127 100
- using quadrivalent vaccine	-	R1 353 900	R501 900	R1 276 000	R490 600
- using quadrivalent plus serogroup B vaccine	-	R5 035 000	R1 876 400	R4 692 500	R1 828 500

Pentavalent vaccine targets serogroups A, C, W, Y, and X; quadrivalent vaccine targets serogroups A, C, W, and Y; DALY – disability-adjusted life-year; ICER – incremental cost-effectiveness ratio.

A meningococcal awareness and education campaign, along with vaccination of first-year students in institutional residences (options 1 and 3), would be the most cost-effective, politically and operationally feasible policy option to reduce meningococcal disease, deaths, and disabilities in students attending tertiary institutions in South Africa.

Meningococcal disease occurs infrequently, and without considering societal costs, the cost of illness in the tertiary student population from a government perspective per year is minimal (R250 200). However, each episode could end or change the life trajectory of the person affected and their family; therefore, this disease should be prevented. The main driver of the programme costs is the vaccines. To hold an awareness campaign and vaccinate all first-year students living in institutional residences (options 1 and 3) could cost the government between R29 and R181 million per year using available meningococcal vaccines (quadrivalent or quadrivalent plus monovalent B vaccine) (Table 3). By procuring an affordable pentavalent meningococcal vaccine, this cost could be reduced to approximately R7.5 million per year, whilst still averting 59 DALYs per student cohort. Using the pentavalent vaccine, the government would be spending R127 100 per DALY averted, which is well within the willingness-to-pay threshold indicative of the cost-effectiveness of the intervention in the South African context.

Recommendations and next steps

Meningococcal disease, although relatively uncommon, is a devastating illness that strikes healthy young adults and can result in sudden death or lifelong disability within hours of onset. In SA, tertiary students are at particularly high risk due to behavioural and environmental factors that increase meningococcal carriage and transmission, especially within institutional residences and other shared-living arrangements. Preventing meningococcal disease is, therefore, a public health imperative and a moral responsibility, given the significant human, social, and economic costs associated with every episode. Vaccination is the only reliable means of primary prevention, and global experience has demonstrated its effectiveness in reducing both carriage and disease. Importantly, SA has committed to the World Health Organization's Roadmap to Defeat Meningitis by 2030, yet meningococcal vaccination remains inaccessible to most students due to high cost, limited availability, and lack of awareness.

Based on the evidence presented, we recommend that the DoH, in partnership with the DHET, implement a dual strategy of (1) meningococcal awareness campaigns at tertiary institutions and (2) targeted vaccination of first-year students living in institutional residences and other shared-living arrangements, subsidised through public funding. This combined approach is evidence-based, cost-effective, and operationally feasible in the current South African context. The imminent registration of a more affordable pentavalent vaccine presents a timely opportunity to implement this strategy at scale, with projected programme costs substantially lower than those associated with existing vaccines.

The next steps should include (1) formal engagement between DoH and DHET authorities and other tertiary institution stakeholders (such as Higher Health) to integrate meningococcal vaccination into student health services; (2) procurement and subsidy of the affordable pentavalent conjugate

vaccine for first-year students in residences; (3) development and roll-out of a national, evidence-based meningococcal awareness campaign using digital, print, and peer-led communication channels; and (4) establishment of a monitoring and evaluation framework to assess vaccine uptake, carriage, and disease trends among students.

By acting decisively, SA has the opportunity to protect its future leaders from a preventable and life-altering disease while honouring its commitment to the Global Roadmap to Defeat Meningitis by 2030.

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Conflicts of interest

SM has acted on an advisory board for GlaxoSmithKline and Sanofi and as an external expert giving educational talks sponsored by GlaxoSmithKline and Sanofi. JB, VQ, ASM, PP, and AvG have no conflicts of interest to declare.

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