of these 3125-SBA titres would be expected after 8 years.[6] These results suggest that a MenAfriVac booster vaccination would currently be required for this group to maintain immune protection.

This uncertainty around the correlate of protection raises some concern. It is worrying that the pathophysiology of serogroup A meningitis found in the African belt is not well understood. One hypothesis is that under the extreme climatic conditions during the dry season (high aerosol load and low air humidity), meningococci can invade the meninges directly from the nasopharynx through the lymphatic tissue along the olfactory nerve.[9] In this scenario, conjugate vaccines are effective primarily, or perhaps only, through their capacity to protect against nasopharyngeal infection. In any case, it is widely accepted that the interrupted pathogen circulation is the main determinant of strong and persistent impact of high-coverage conjugate vaccine programmes.[1] The key factor to evaluate, then, is the mucosal immunity induced by conjugate vaccines. Unfortunately, there is even less understanding of how this mucosal immunity works. No validated measures are available, although salivary antibodies might be candidates.[10,11] For now, the sole way to evaluate the vaccine-induced protection against asymptomatic infection is through large and costly carriage studies.

The pragmatic approach is to acknowledge that conjugate vaccines work well, particularly because of indirect protection, and that further evaluation is necessary only if *N meningitidis* serogroup A epidemics re-emerge. Furthermore, a vaccine against five meningococcal serogroups (A, C, W, X, and Y) is being developed[1] and its introduction through mass campaigns will provide a booster against *N meningitidis* serogroup A.

To move forwards, my wish would be to see the development of a simple, specific test of mucosal immunity against meningococci, which would allow for the follow-up assessment of protection against asymptomatic nasopharyngeal infection among trial participants and vaccinated populations. Mathematical modelling based on such data will allow estimation of the duration of both direct and indirect protection after vaccination and thus offer a powerful tool to develop strategies for long-term control of meningococcal meningitis.

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I declare no competing interests.

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# Twitter to engage, educate, and advocate for global antibiotic stewardship and antimicrobial resistance

The WHO Global Action Plan on Antimicrobial Resistance recommends countries work together to improve awareness and understanding of antimicrobial resistance, including through social media.[1,2] Twitter disseminates news in seconds around the world in real-time to anyone with an internet-connected

device. Twitter can serve as a conduit for global antimicrobial resistance education and engagement between health-care profressionals, policymakers, and the general public alike. The 2018 World Antibiotic Awareness Week campaign used Twitter to tailor media messages about the Global Action Plan.[3] In a 2018 global analysis by Pew Research Center,[4] 53% of respondants indicated they use social media like Twitter, with 46% visiting Twitter at least once per day.

4 years have passed since a review of the usefulness of Twitter for infectious diseases clinicians was published.[5] An increased uptake of Twitter has occurred since then. Here we highlight how Twitter is useful in the infectious diseases community and how key infectious diseases organisations engage with individuals providing education to aide understanding of antimicrobial resistance.

The British Society for Antimicrobial Chemotherapy operates @TheUrgentNeed, which promotes their public engagement group, Antibiotic Action, to share news, connect individuals, influence media and public policy, and promote public health messages about the responsible use of antibiotics. @TheUrgentNeed has more than 9000 followers from 131 countries. The US Centers for Disease Dynamics and Economic Policies (@CDDEP) uses Twitter to engage with followers in 108 countries on topics including antimicrobial resistance, vaccines, and publications. The US Center for Infectious Disease Research and Policy (@CIDRAP_ASP) engages with individuals from 83 countries often using the hashtag #ASPJournalClub to host Twitter chats with subject matter experts. This method of focused live-tweeting on nuanced subjects is not easily accessed elsewhere. The US Society of Infectious Diseases Pharmacists (@SIDPharm) was a top influencer at the 2018 Infectious Diseases Society of America IDWeek national conference, live tweeting breaking news in real-time, extending the reach of new data beyond the walls of the meeting. The South African Antibiotic Stewardship Programme (@Southafricanasp) engages with followers in 82 countries. An infectious diseases specialist tweets antibiotic stewardship-related information relevant to low-income and middle-income countries, and to build the stewardship community in South Africa.

Twitter is valuable during disease outbreaks. Traditionally, public health research relies on surveillance strategies, such as case reporting and patient interviews, to report infectious disease outbreaks; however, these strategies require extensive time and resources. Young and colleagues[6] data mined Twitter to assess whether it could predict syphilis cases in 2013 on the basis of 2012 data. They used data reported to the US Centers for Disease Control and Prevention (CDC) and 8500 geolocated tweets in the USA that were filtered to include sexual risk-related keywords. A significant positive relationship between tweets and cases of syphilis was found. In low resource settings, Twitter might provide an inexpensive tool for surveillance.

Additionally, Twitter chat, a two-way public conversation around a unique hashtag, has been a useful mechanism for engagement. Participants post questions or responses to the host and receive answers in real-time. For instance, during World Antibiotic Awareness Week 2018, the CDC coordinated a global Twitter storm using hashtag #AntibioticResistance to engage the world on antimicrobial resistance discussions. 1 year earlier, during World Antibiotic Awareness Week, the CDC hosted a Twitter chat on antibiotics and the Society of Infectious Diseases Pharmacists hosted one on *Clostridium difficile* infections to engage health-care professionals and the public. The 2018 European Antibiotic Awareness Day tweeted live using the hashtag #EAAD and #KeepAntibioticsWorkings to answer questions and engage with health-care professionals, farmers, policymakers, professional and patient organisations, governmental institutions, and the general public.

Consumer advocates have a strong presence on Twitter. Patients' voices are often left out of the antimicrobial resistance discussion. Twitter provides a platform for patients' voices to be heard. The Peggy Lillis Foundation (@PeggyFund), is a *C difficile* infection awareness organisation educating the public and shaping policy. Tweets with links to educational tools and video testimonials from patients with *C difficile* infection provide powerful engagement and education to consumers. Another example is patient survivor @_FaceSA with more than 5500 followers. She uses the hashtag #HCSMSA (health care social media South Africa) to host Twitter chats featuring infectious diseases global experts to supplement the chat and engage policymakers, health-care professionals, and consumers on how antimicrobial resistance affects one's life.

Overall, Twitter is an efficient channel for information sharing among health-care professionals, policymakers, and the general public who can actively participate with leaders and experts worldwide, at any time, at no cost. Encouraging more health-care professionals to tweet on antimicrobial resistance can bring us closer to achieving WHO's goal of improving awareness and understanding of antimicrobial resistance.

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We declare no competing interests.

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# Latent tuberculosis infection: diagnostic tests and when to treat

Latent *Mycobacterium tuberculosis* infection is defined by WHO as "a state of persistent immune response to *M tuberculosis* antigens with no evidence of clinically active tuberculosis disease".[1] An estimated 1·7 billion people worldwide have latent tuberculosis infection, of whom up to 10% are at risk of reactivating into active tuberculosis during their lifetime.[2] Latent tuberculosis infection can be effectively treated and this can prevent progression to active tuberculosis, benefitting both the individual and the community. Treatment regimens for latent tuberculosis infection[1] reduce the risk of developing active tuberculosis by at least 60%.[1,3] To achieve the 2035 and 2050 End TB Strategy goals,[4] the very challenging and arduous task of screening and treating this huge latent tuberculosis infection reservoir needs to be addressed.

The 2018 WHO latent tuberculosis infection guidelines[1] recommend latent tuberculosis infection screening and treatment should focus on people at a high risk of latent tuberculosis infection reactivation regardless of background epidemiology, particularly people living with HIV and children younger than 5 years who are household contacts of pulmonary tuberculosis patients in all settings. Other groups recommended for latent tuberculosis screening include anyone initiating anti-tumour necrosis factor treatment, receiving dialysis, preparing for organ or haematological transplantation, or with silicosis. In countries with a low prevalence of tuberculosis, such as the USA, a large proportion of people who are diagnosed with active tuberculosis appear to have developed the disease from untreated latent tuberculosis infection.[5] Thus, all high-income countries now have proactive latent tuberculosis infection screening and treatment programs for all new migrants and refugees.

Despite two decades of research, no gold standard diagnostic tests exist for latent tuberculosis infection. Currently three latent tuberculosis infection tests are recommended by WHO:[1] the tuberculin skin test (TST) and two interferon-γ release assays (IGRAs), QuantiFERON-TB Gold In-Tube and T-SPOT TB. False negative IGRA tests have been reported in 12% of active tuberculosis cases[6] and in 28·8% of patients with extrapulmonary tuberculosis.[7] The effects of latent tuberculosis infection tests on patient management outcomes or on tuberculosis control programmes