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Lessons for and from the COVID-19 pandemic response – An appraisal of guidance for the public health management of Invasive Meningococcal Disease



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ABSTRACT

Background: COVID-19 has focussed public attention on the management of communicable disease like never before. Surveillance, contact tracing, and case management are recognised as key components of outbreak prevention. Development of guidance for COVID-19 has drawn from existing management of other communicable diseases, including Invasive Meningococcal Disease (IMD). IMD is a rare but severe outcome of *Neisseria meningitidis* infection that can be prevented through vaccination. Cases still occur sporadically, requiring ongoing surveillance and consistent management. To this end, national and international public health agencies have developed and published guidance for identification and management of IMD cases.

Aim: To assess national and international guidelines for the public health management of IMD, with a focus on the recommendations for identification and management of “close contacts” to IMD cases.

Methods: Guidelines from six national and international public health agencies were assessed using a modified version of the Appraisal of Guidelines, Research and Evaluation (AGREE II) Instrument in four key domains: stakeholder involvement, developmental rigour, clarity, and applicability. A direct comparison of terminology and recommendations for identification and management of close contacts to IMD cases was also conducted.

Results: Guidelines from Europe and the United Kingdom rated most highly using the AGREE II Instrument, both presenting a clear, critical assessment of the strength of the available evidence, and the risks, costs, and benefits behind recommendations for management of close contacts. Direct comparison of guidelines identified inconsistencies in the language defining close contacts to IMD cases.

Conclusion: Discrepancies between guidelines could be due to limited evidence concerning mechanisms behind disease transmission, along with the lack of a consistent process for development and review of guideline recommendations. COVID-19 management has demonstrated that international collaboration for development of public health guidance is possible, a practice that should be extended to management of other communicable diseases.

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Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has brought communicable disease management into the spotlight.

Societal discussion around the role of public health agencies in the prevention and control of infectious disease outbreaks has never been more important. One major point of focus is the role of disease surveillance within outbreak suppression strategies. Countries that acted swiftly and decisively when setting guidance for the identification and management of COVID-19 cases and close contacts often saw greater success in suppressing outbreaks and avoiding heavy case burdens. Notable examples include Australia, Taiwan and New Zealand [1].

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The rapid development of guidelines for the management of COVID-19 in different jurisdictions across the world has, necessarily, drawn from guidelines for the management of other infectious diseases [2]. Differences in the public health management for other infectious diseases may help to partially explain some of the marked differences in approaches between countries.

The COVID-19 pandemic and ensuing public health measures including physical distancing, lockdowns, and contact tracing, has led to palpable reductions in the incidence of other communicable diseases [3,4]. It is thus timely to compare guidelines for the management of other communicable diseases across a range of jurisdictions to inform the evolution of guidelines for the management of COVID-19 alongside a more unified update of guidance for other communicable diseases.

A French study investigating the effect of COVID-19 lockdowns on communicable disease identified a decrease in highly transmissible and hyperinvasive strains of Invasive Meningococcal Disease (IMD) over the same time period lockdowns were in place [4]. IMD is a severe disease caused by *Neisseria meningitidis* (*N. meningitidis*), a bacteria found in the human nasopharyngeal mucosa, the cells lining the back of the nose and throat [5]. The disease has a rapid onset and cases require prompt antibiotic treatment to prevent mortality [12,13]. Survivors of IMD often suffer from serious long-term sequelae, including – but not limited to – loss of limbs, neurological damage, hearing loss and physical or psychological scarring [6]. Infants (<1 year old) are the most commonly affected age group, with a small increase in incidence for teenagers and the elderly [7]. While IMD is relatively rare in developed countries (age standardised incidence of 0.5–20 cases per 100,000 in 2016 [8]), *N. meningitidis* can be carried and transmitted asymptotically throughout the general population, with carriage rates ranging between 10–20%. The mechanisms for transmission are not well understood [9], but it is known that close, sustained contact between people creates optimal conditions for spread of *N. meningitidis*.

IMD is preventable through vaccination, with vaccines available to cover five of the six most common disease-causing strains (A, B, C, X, Y, and W) [4,10–13]. Carriage of *N. meningitidis* can be prevented through the use of clearance antibiotics (chemoprophylaxis), for contacts of cases – that is, those people who have had close and sustained interactions with cases.

As is the case with COVID-19, ongoing public health management of IMD is required to prevent the development of community outbreaks. This is achieved through two main mechanisms: vaccination of the general population to reduce overall incidence; and disease surveillance and contact tracing to prevent the spread of IMD from carriers.

When IMD cases are identified, staff in public health units are responsible for identifying and classifying all possible contacts to the case. These contacts are then classified by the likelihood of *N. meningitidis* transmission. “Close contacts” have the highest risk of transmission and are managed with chemoprophylaxis to eliminate carriage of a possible disease-causing strain of bacteria. Depending on the disease-causing strain and availability of vaccination, close contacts may also be offered a strain-specific vaccine to reduce the risk of developing symptoms [14].

For staff with responsibility for contact identification and classification, guidance around IMD management comes in the form of guideline documents, usually written by national public health agencies, such as the United States Centers for Disease Control (CDC) and Prevention, or the New Zealand Ministry of Health. Within Australia, these guidelines have been developed by the Communicable Diseases Network Australia (CDNA), an advisory group for the Australian Government that provides unified national guidance for the management of communicable diseases [2,15]. These guidelines outline the recommended public health response

– how to identify, classify and manage contacts, what antibiotics and vaccinations to provide, and guidance on how to communicate with contacts – which is then implemented by public health staff when responding to IMD cases.

While many countries have guidelines written for the public health management of IMD, there has been no comparison or analysis of this guidance on an international level. There is limited evidence around the actual risk of transmission between cases and contacts, especially close contacts, as IMD is uncommon and epidemiology varies globally [16].

An assessment of national and international guidelines for the public health management of IMD, accompanied by a summary of the literature around guideline development and use, will provide a better understanding of guideline implementation in public health settings, and may help to inform the evolution of guidelines for the ongoing prevention of communicable diseases, such as COVID-19. The primary purpose of this review is to assess national and international guidelines for the public health management of IMD, and, more specifically, identification and management of close contacts. A secondary purpose is to characterise and evaluate similarities and differences between guideline recommendations for the identification and management of close contacts.

Methods

Guidance for the public health management of IMD cases and contacts were sourced from countries with similar incidence of IMD to Australia [8]. Each national public health agency (or equivalent authority) was identified by searching the country name and “department of health” using Google. Agencies websites were then searched using the terms “meningococcal” OR “meningitis” AND “guidelines” OR “publication” to identify any publicly available resources for staff about the management of IMD cases and contacts. Any English-language guidelines identified that included recommendations for IMD case and contact management were eligible for inclusion in this review. This search was not date limited, however only the most recent published version of each agency’s public health guidelines for the management of IMD cases and contacts was assessed. One international body, the European Centre for Disease Prevention and Control (ECDC), was also included as they provide overarching public health guidance to non-English-speaking European Union (EU) countries, that otherwise would not be included in this review. All screening was conducted by a single author. Any queries were discussed by the team of researchers, and disagreement resolved by consensus.

Guidelines were assessed using a modified version of the Appraisal of Guidelines, Research and Evaluation (AGREE II) Instrument. The AGREE II Instrument is a pre-verified tool, designed to ‘assess the quality of practice guidelines across the spectrum of health, provide direction on guideline development, and guide what specific information ought to be reported in guidelines’ [17]. The original AGREE II consists of 23 items, organised into six quality-related domains: scope and purpose, stakeholder involvement, rigour of development, clarity of presentation, applicability, and editorial independence. Each item consists of a concept, for example, ‘the recommendations are specific and unambiguous’ [18], which the assessor then rates on a scale of 1–7. A score of 7 indicates the concept is fully explained and articulated, and a score of 1 indicates a total absence of information. Item scores can then be grouped by domain, indicating areas where guidelines may lack clarity or purpose.

The AGREE II instrument was chosen for the present review because of its focus on assessing the methodological rigour behind the development and reporting of guidelines, rather than the validity of the recommendations themselves. It has been used in its

Table 1
Modified AGREE II Instrument scores by domain and overall, for national and international guidelines (displayed in ascending order of year of publication).

Jurisdiction	Year	Domain scores				Total score (out of 84)
		Stakeholder involvement (out of 14)	Rigour of development (out of 35)	Clarity of presentation (out of 21)	Applicability (out of 14)	
Canada	2006	13	31	19	11	74
Europe (ECDC)	2010	14	35	21	12	82
Australia	2017	8	28	19	10	65
United States (US)	2011	5	25	21	9	60
New Zealand	2018	7	20	20	10	57
United Kingdom (UK)	2018	11	34	21	13	79

original form to assess national and international guidelines in many specialty fields of health, such as maternal [19,20], cardiac [21], and respiratory health [22]. As all the guidelines being assessed were written for the same purpose (public health management of IMD) and produced by public health staff or specific government-funded working groups, the 'scope and purpose' and 'editorial independence' domains in the original instrument were omitted. This left four domains, and twelve items in the modified AGREE II instrument. The scoring system was retained, such that each item was given a score between 1 and 7, with the item scores summed according to domain. The number of items differs across the four domains, with 'stakeholder involvement' and 'applicability' each having two items (maximum possible score = 14), clarity of presentation' three items (maximum possible score = 21), and 'rigour of development' five items (maximum possible score = 35). Item scores were summed and presented by domain, alongside an overall score out of the maximum possible total of 84 for each set of guidelines.

In addition to the AGREE II scoring, a direct comparison of language used and recommendations for identification and management of close contacts between guidelines was conducted. This comparison included each guideline's definition of a close contact, antibiotic recommendations, and vaccination recommendations for close contacts.

Results

Public health guidelines from Australian [15], Canadian [23], European [14], New Zealand [24], United States (US) [25], and United Kingdom (UK) [26] health agencies were included (n = 6). The results from application of the modified AGREE II instrument to these six guidelines are shown in Table 1. All guidelines scored highly (i.e. >75% of maximum possible domain score) in the 'clarity of presentation' domain. Four guidelines scored highly in 'rigour of development' (Canada, Europe, Australia, UK), and three scored highly in 'applicability' and 'stakeholder involvement' (Canada, Europe, UK).

Overall, four guidelines – Canada, Europe, Australia, and the UK – scored above 63/84 (75%). The European guidelines scored highest overall when using the modified AGREE II criteria (82/84), followed by the United Kingdom (79/84). Both sets of guidelines clearly showed the strength of the evidence behind each recommendation, included key information summaries within each section, and addressed possible barriers and facilitators to guideline implementation. The Canadian and Australian guidelines were both clearly written with key information summaries readily available throughout the documents. However, the discussion around the strength of the evidence was more limited in each of these guidelines, and the Australian guidelines showed much less evidence of stakeholder involvement. While clearly written, the US guidelines scored 60/84, reflecting that there was little discussion in these guidelines around stakeholder involvement and applicability. The New

Zealand guidelines scored lowest (57/84), with little in-depth discussion around any of the concepts that underpin the items in each domain. Notably, there was no apparent trend in scores related to their date of publication.

All guidelines emphasised the importance of prompt identification and management of close contacts to minimize the risk of additional cases of IMD. There was consistency across all guidelines regarding the exposure period – 7 days before onset of symptoms in the case to 24 h on effective antibiotic treatment – and on household contacts qualifying as 'close' contacts, shown in Table 2.

Canada had the oldest published guidelines (2006) and the broadest definitions for close contacts, including sharing drinks and cigarettes as an indication of close contact. As seen in Table 2, three out of the six guidelines included co-passengers (seated directly adjacent to an IMD case on travel lasting longer than 8 h) to cases as close contacts. All of these guidelines specified an 8-h minimum time and included any form of enclosed transport [15,23,24]. Only Australia defined a minimum time of contact for childcare settings (two full days or 20 cumulative hours in the same care group, based on a 1981 study on secondary case rates after IMD outbreaks in Belgian children [27]) [15]. Other guidelines left it to the discretion of the public health officer [20] whether to include childcare contacts as close contacts, or did not include childcare contacts at all [24,26].

With the exception of the US guidelines, vaccination was recommended for all unimmunised close contacts, provided the disease-causing strain could be identified. European and Canadian guidelines recommend vaccination 'if a case of meningococcal disease is caused by a strain that is preventable by an available licenced vaccine' [14]. Australian, UK and New Zealand guidelines specify A, C, W, Y conjugate vaccines, and either do not discuss the use of meningococcal B vaccination (Australia) or limit use to multiple cases occurring in the same household (UK, New Zealand).

Each of the guidelines considered here recommended Rifampicin, Ceftriaxone, and Ciprofloxacin for the elimination of carriage (chemoprophylaxis) within close contacts. Two (US and UK) guidelines also included Azithromycin as an additional option. The European guidelines included Cefixime in addition to Rifampicin, Ceftriaxone, and Ciprofloxacin. Dosages, recommended age, duration, and cautions in usage were all identical across the guidelines.

Discussion

This study has shown that guidelines with higher scores based on the AGREE II Instrument clearly and critically assessed the strength of the available evidence to make recommendations for identification and management of IMD close contacts. Higher scoring guidelines also detailed the potential risks, costs and benefits of each recommendation. This is demonstrated by the European and UK guidelines, both of which clearly identified and discussed the strength of the evidence behind each recommendation. Other guidelines, such as those produced by the US and New Zealand,

Table 2
Summary of terminology, definition of “close contact” and recommendations for management in national and international public health guidelines.

Jurisdiction	Year	Terminology	Close contact definition	Antibiotic recommendations	Vaccination recommendations
Canada	2006	Close contacts	Household Co-sleepers Direct contamination of nose/mouth (e.g. shared cigarettes/drinks, kissing) Healthcare workers ^a Children and staff in childcare/nursery settings Co-passengers ^b	Rifampicin, Ceftriaxone, Ciprofloxacin	Yes, if the contact is unimmunised and there is a vaccine available for that strain.
Europe (ECDC)	2010	Close contacts	Household Pre-school (dependent on risk assessment)	Rifampicin, Ceftriaxone, Ciprofloxacin, Azithromycin	Yes, if the contact is unimmunised and there is a vaccine available for that strain.
Australia	2017	Higher risk contacts	Household/household like Intimate kissing/sexual Child-care Co-passengers Healthcare workers	Rifampicin, Ceftriaxone, Ciprofloxacin	A, C, W, Y conjugate vaccines if contact is unimmunised, 4CMenB (Bexsero) vaccine only if there is a second case of serogroup B in the same household.
United States (US)	2011	Close contacts	Household Childcare centre contacts “Anyone directly exposed to oral secretions” (kissing, mouth-to-mouth resuscitation, intubation/tube management)	Rifampicin, Ceftriaxone, Ciprofloxacin, Azithromycin (if there is no resistance to fluoroquinolone)	Not discussed.
New Zealand	2018	Contacts	Household Bed/room sharing overnight Co-passengers Healthcare workers “Other contacts as determined on a case-by-case basis by the medical officer”	Rifampicin, Ceftriaxone, Ciprofloxacin	MenACWY conjugate vaccine if contact is unimmunised, Bexsero (meningococcal B) if there is a multi-occupancy outbreak
United Kingdom (UK)	2018	Close contacts	Household/household like	Rifampicin, Ceftriaxone, Ciprofloxacin, Azithromycin (for pregnant women)	MenACWY if contact cannot confirm immunisation in the preceding 12 months, MenB only if contact is at increased risk of meningococcal infection

^a Directly exposed to nasal secretions (e.g. mouth-to-mouth or intubation of a known IMD case).

^b Seated directly adjacent to a known IMD case, for travel lasting longer than 8 h on an airplane, boat, bus, train or other enclosed transport.

had lower overall scores when they showed no clear link between the evidence and recommendations given, did not provide explicit recommendations, relied on limited evidence, or did not provide information on possible barriers and facilitators to implementation of guideline recommendations.

Public health staff require clear and accurate guidance in order to effectively identify and reduce the risk of further IMD cases arising from contacts of those cases [28]. Domains within those guidelines with lower scores in the AGREE II Instrument indicate areas where public health staff lack consistent and explicit guidance on how to carry out their role concerning management of close contacts. This could in turn make it more challenging for staff to properly implement such guidelines when presented with a case of IMD.

One important point to bear in mind is that the primary purpose of the AGREE II Instrument is to assess the quality of the underlying methodology and reporting of guidelines, and not the assessment of the accuracy of any recommendations provided. Therefore, the scores from evaluation according to the AGREE II Instrument should also be considered within the context of the findings from Table 2. Guidelines assigned higher scores using the AGREE II Instrument may not necessarily be providing the most up-to-date or evidence-supported guidance. While recommendations for antibiotic treatment were largely consistent across the guidelines assessed in the present review, information about vaccination varied between countries. This is in part due to the publication date of some guidelines. For example, the Bexsero meningococcal B vaccine, mentioned in Australian, UK and New Zealand guidelines, was

only licenced in the UK in 2013, and has only been included in the national immunisation programs of seven countries including Australia [16] to date. The definition of a “close contact” was also quite varied, and ranged from household and household-like contacts alone [26] to household, household-like, sexual, child-care, co-passengers and healthcare contacts [15].

In general, the development of guidance for the public health management of a given communicable disease rests on a body of evidence describing the aetiology and epidemiology of that disease. Evidence may be derived from studies investigating many different facets of the disease, including – but not limited to – causative pathogen(s), symptom progression, transmission patterns and population prevalence. In the case of IMD, the ability of researchers to study the life cycle and host interactions of *N. meningitidis* is limited, largely due to its adaptation to human airways [5,29]. While mouse models can be used to model disease symptoms and infection mechanisms, they require manual inoculation with the bacterium, and are not well-suited to studying transmission patterns [29]. Studies on the prevalence of asymptomatic carriage have largely focussed on sub-populations already known to have higher rates of carriage, and often utilize surveys and questionnaires to identify factors that may affect an individual’s risk of carriage [30–32]. Guideline recommendations are then based on the generalised results of these population studies, in addition to public health records of previous IMD clusters [28] and published evidence on the transmission risk of similar bacterial pathogens (e.g. tuberculosis) [33].

A 2016 study [34] of public health guidance for the management of close contacts to IMD cases within EU countries discussed the variation between country policies for identification and management of close contacts. The study is a repeat of a 2007 survey [35], and indicated that following the publication of the ECDC guidance in 2010, EU countries had adopted more evidence-based public health guidance, that were better aligned with ECDC recommendations. This indicates that while there is a somewhat limited understanding of the risks affecting transmission of *N. meningitidis*, it has become more widely accepted that to be at a higher risk of transmission, a certain degree of close, sustained contact is required [16,28,36,37].

While there was no clear link between AGREE II scores and date of guideline publication, definitions of close contacts did change over time. For example, Canadian guidelines had the earliest publication date (2006) and the broadest inclusion criteria for close contacts. More recent guidelines, such as those from the UK (2018) or the US (2017), have a more restricted definition of a close contact and had a stronger evidence base to support their recommendations.

The present review of guidelines was limited to high-income and predominantly English-speaking countries. While all of the included jurisdictions had a similar incidence of IMD, the disease is rare in those areas [8]. EU countries were also grouped under the ECDC guidance, as none of the individual member states had publicly available English-language guidelines. The comparisons published by Vygen et al. [34] and Hoek et al. [35] provided insight on the similarities and differences between EU countries with regards to their management of IMD case contacts, although a direct assessment of individual EU countries public health guidelines was not carried out in either of these studies. Another consideration in interpreting the work presented here is that the AGREE II Instrument is predominantly designed for the assessment of clinical guidance. While it provided valuable insight into the development and reporting of public health guidance around IMD prevention, there are aspects of the guidelines assessed that the AGREE II instrument does not cover. These include healthcare costs, recommendations for review of guidelines, methods for guideline dissemination to public health staff, recommendations for audit,

and assessment of guideline implementation. There are also considerations for the assessment of clinical guidelines that are not relevant to the assessment of public health guidelines. In our study, this limitation was mitigated by the removal of the ‘Scope and Purpose’ and ‘Editorial Independence’ domains from the original AGREE II Instrument.

COVID-19 management has, by necessity, streamlined the process of translating evidence into public health policy (e.g. mask wearing, hotel quarantine, lockdown strategies) [1,2]. While responses to the COVID-19 pandemic have reduced the spread of IMD and other communicable diseases [4,38], they have also impacted vaccination programs [3,39] and may negatively impact outbreak management strategies. The current delay between increased understanding of disease transmission and actual implementation into public health guidance can have direct and immediate consequences for individual and population health.

Mechanisms for guideline development and review should prioritize the identification of areas where guidelines may lack clarity, be inconsistent, or have weak underlying evidence. This information can then be used to improve the clarity and consistency of public health recommendations. Guideline development and revision should also be considered frequently within a global context, ideally with the introduction of new vaccines or vaccination programs, as it becomes increasingly evident that inconsistent management of an infectious disease, either within or between country jurisdictions, can hinder effective disease management. Although conjugate meningococcal vaccines show evidence of reduction in transmission [13], they do not affect overall carriage rates [40]. As new vaccines are developed and implemented in population-wide programs, guidelines for management of contacts need to be reviewed to ensure they remain contemporaneous.

Conclusions

The present study has shown inconsistencies between higher-income countries for the public health management of IMD case contacts. Most notably, the definitions used to identify close contacts differ between countries. Limited availability of evidence surrounding the risk factors for transmission and disease development amongst IMD case contacts, in addition to the lack of a widely accepted process for guideline development and review, may be contributing to these inconsistencies.

The facilitation of effective and multi-jurisdictional responses to communicable disease outbreaks rests on global cooperation and unified guidance. A pre-planned stage of international review within the guideline development process, so as to promote the consideration of recommendations for disease management put forth by other jurisdictions, could be adopted to achieve this. This process could be guided and implemented by internationally recognised bodies such as the World Health Organisation or the ECDC. Worldwide, responses to the COVID-19 pandemic demonstrate that public health guidance can be updated rapidly as new information is gleaned, and those changes can be quickly communicated to relevant staff and the wider public.

Response to the COVID-19 pandemic has resulted in a level of international cooperation that would have been considered unachievable previously. This singular focus on disease prevention can – and should – be carried forward into the management of IMD and other communicable diseases. International collaboration for guideline development and implementation must continue to be the cornerstone of communicable disease response and management.

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Competing interests

None declared.

Ethical approval

Not required.

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