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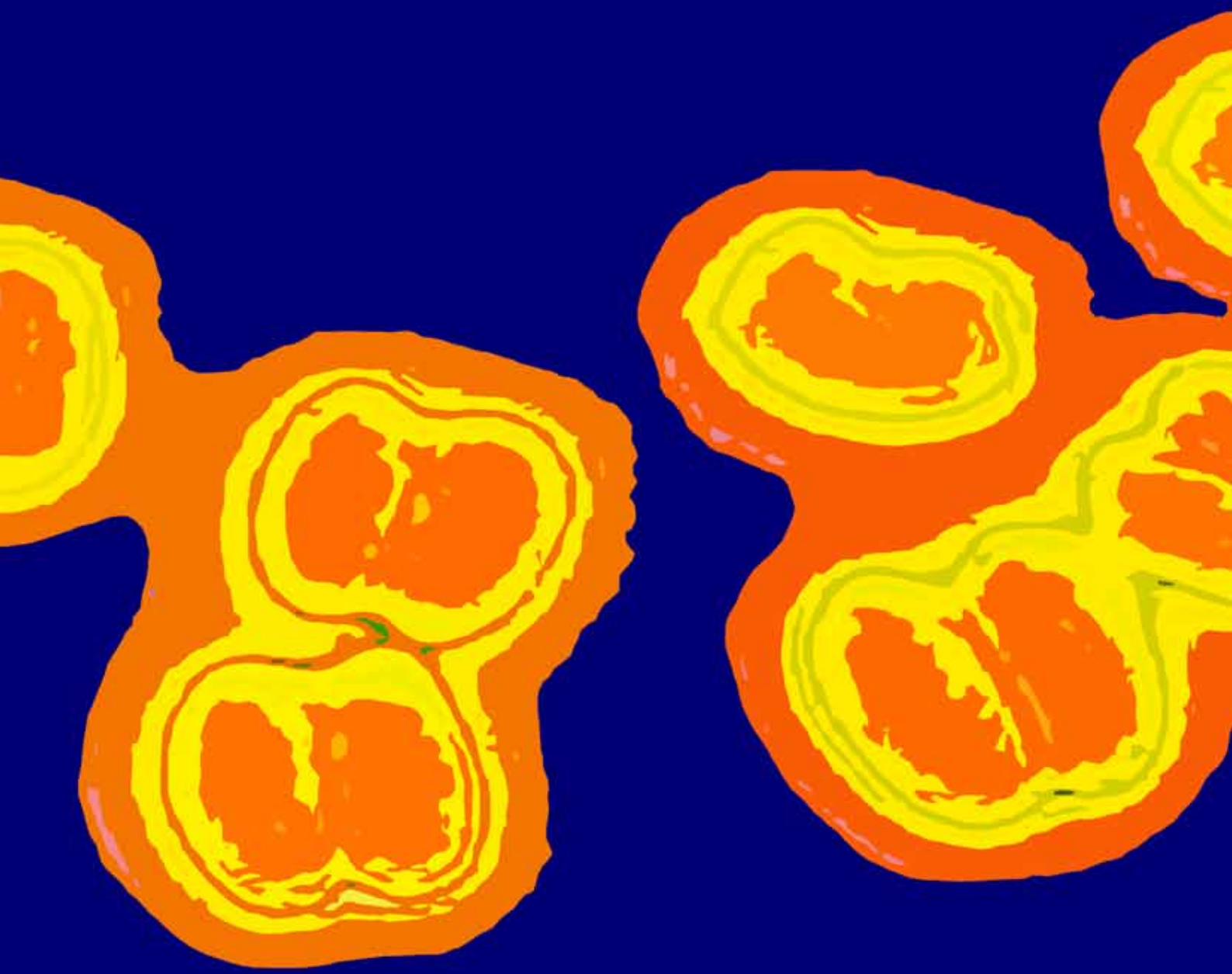

Guidelines for the Early Clinical and Public Health Management of Bacterial Meningitis (including Meningococcal Disease)

Report of the Scientific Advisory Committee of HPSC

DOCUMENT CONTROL

Title	Guidelines for the early clinical and public health management of bacterial meningitis (including meningococcal disease)
Document Purpose	To promote best practice management of bacterial meningitis (and meningococcal disease) in primary care and at hospital level To standardise practice To ensure that GPs, hospital and public health clinicians are clear on roles and responsibilities To act as an educational tool To act as a basis for audit and evaluation
Target Audience	Health care staff dealing with patients where a diagnosis of bacterial meningitis or septicaemia is suspected
Revision Number	3
Document Approved by	Scientific Advisory Committee, Health Protection Surveillance Centre
Document Developed by	Bacterial Meningitis Sub-Committee of the Scientific Advisory Committee, HPSC
Responsibility for Review and Audit	Hospitals, Departments of Public Health, HPSC
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Note: The November 2016 revised edition includes updates to the following sections:

Chapter 4. Invasive pneumococcal Disease case definition-updated

Chapter 7. Public health management of sporadic cases of meningococcal disease. Updates to vaccines available and recommended in Ireland, including Meningococcal B vaccine.

Chapter 9. Chemoprophylaxis. Recommendations regarding chemoprophylaxis use of ciprofloxacin.

CONTENTS

BACKGROUND TO THE GUIDELINES

Introduction

Bacterial meningitis or septicaemia is a serious condition with high morbidity and significant mortality. Individuals with this disease can present in the community and deteriorate rapidly prior to admission to hospital. Early recognition, treatment and referral to hospital improves patient outcome. Despite the introduction of routine immunisation to prevent meningococcal C disease and the subsequent decline in disease incidence, there continues to be an important role for rapid and targeted public health control measures to prevent the spread of disease.

These guidelines update previous guidance issued by the Department of Health and Children (DoH) in 1999 (Guidance on the Management of Meningococcal disease - Working Group Report on Bacterial Meningitis and Related Conditions 1999).

Purpose and Scope

The purpose of these guidelines is to provide comprehensive guidance on the early clinical and public health management of bacterial meningitis (including meningococcal disease, *Haemophilus influenzae* type b disease and clusters of serious pneumococcal disease).

The guidelines address sporadic cases, clusters of cases occurring in the community, chemoprophylaxis, vaccination and communications.

These guidelines are intended to

- Promote best practice
- Standardise practice and service delivery
- Ensure that legislative requirements are met
- Ensure that clinicians are clear on their roles and responsibilities
- Facilitate effective staff induction
- Act as an educational tool
- Act as a basis for audit and evaluation.

The guidelines are necessarily general and those using the guidelines are advised to seek expert advice on the management of cases (from clinical microbiologists, infectious disease physicians, infection control, public health physicians, and occupational health physicians) as required.

The guidance can be adapted depending on local circumstances and risk assessment of each suspected case or situation.

Setting: Any community or clinical setting where a patient presents with the signs and symptoms of an acute systemic febrile illness for which the clinician suspects a diagnosis of bacterial meningitis or septicaemia, for example in primary care, hospital or other setting.

Population: These guidelines apply to all patients in whom bacterial meningitis or septicaemia is suspected and their close contacts; adults and children; institutions or settings where cases occur.

Time: For patient: during pre-admission, in Emergency department of hospital, and while hospitalised. For the family, close contacts, community following diagnosis of suspect bacterial meningitis.

Content

The guidelines cover the following aspects of management:
Pre-admission management, hospital management, surveillance, laboratory diagnosis, public health management of sporadic cases of meningococcal disease, chemoprophylaxis, infection control. Although the focus is mainly on meningococcal disease the management of *H. influenzae* type b and clusters of serious pneumococcal disease is also considered.

The main questions covered by the guidelines are:

- Pre-admission management of bacterial meningitis or septicaemia
- Hospital management of bacterial meningitis or septicaemia
- Laboratory diagnosis of bacterial meningitis or septicaemia
- Identification and management of close contacts
- Chemoprophylaxis to use for cases and their close contacts
- Action required when clusters of disease are identified or suspected
- Communications with the community when bacterial meningitis is notified
- Recommended Infection control
- Vaccination recommendations (if appropriate).

Methods

Working group

The working group which developed the guidelines is a sub-committee of the Scientific Advisory Committee (SAC) of the Health Protection Surveillance Centre (HPSC) and included professionals with the relevant expertise and experience and target users of the guidelines. The disciplines represented were paediatrics, intensivists, infection prevention and control nursing, infectious diseases, medical microbiology, occupational medicine and public health medicine. The members were chosen to represent a professional body or because of their individual expertise. The Irish College of General Practitioners (ICGP) was unable to provide a representative but agreed to be available for consultation during the course of the guidelines development. The members of the working group and the organisations they represent are listed.

Search protocol

In developing the recommendations in these guidelines various sources of guidance were reviewed. Initially, existing guidelines for the management of meningococcal disease were reviewed both nationally and internationally (specifically English speaking countries). Existing Irish guidelines on immunisation were included in this review.

International documents were also examined from a number of sources, e.g. National Institute for Health and Clinical Excellence (NICE) guidelines, Centers for Disease Control and Prevention (CDC), European Centre for Disease Prevention and Control (ECDC), Health Protection Agency (UK), Australian Government Department of Health and Ageing, Cochrane Database of Systematic Reviews, among others. Information which was deemed relevant for the purpose of developing these guidelines was extracted from these sources by working group members and then discussed at the working group meetings to ensure that the guidance selected was appropriate for use in various settings throughout Ireland.

Comprehensive reviews of reliable published resources were conducted by the working group members. A new detailed systematic review was not considered necessary, as it was felt by committee members that this would only replicate reviews which have already been published elsewhere. Available published resources were thoroughly reviewed and their recommendations were appraised by the working group in terms of the reliability of the source, as well as their applicability and operability within Irish healthcare settings.

Where insufficient evidence or guidance was available from these sources, or where there were discrepancies in the information or recommendations from several reliable sources, evidence was sought from original research published in journal articles.

A recognised limitation during the development of these guidelines was that, in some areas, clear evidence from research was not available. Where discrepancies or gaps existed in the available guidance and evidence, expert opinion was sought.

Consultation

The consultation exercise was carried out as follows:

The draft document was sent to the HPSC Scientific Advisory Committee in October 2011 and to key stakeholder groups and individuals for consultation in October 2011.

The draft document was placed on the HPSC website for general consultation on October 18th 2011. A notice about this posting appeared in the HPSC monthly on-line bulletin, Epi-Insight, on November 1st 2011. The consultation period closed on November 29th 2011.

Feedback was received from the following individuals or organisations they represented:

- Dr Anthony Breslin on behalf of Dept. Public Health, HSE North West
- Ms Aisling Clancy, Senior Pharmacist, Antimicrobials, Letterkenny General Hospital, Co Donegal
- Dr Robert Cunney, Consultant Microbiologist, HPSC and Children's University Hospital, Temple Street, Dublin 1
- Professor Martin Cormican, Medical Microbiology, University Hospital Galway, Galway
- Ms Linda Glennie, Clodagh Hegarty, on behalf of Meningitis Research Foundation, UK
- Dr Fidelma Fitzpatrick, Consultant Microbiologist, HPSC and Beaumont Hospital, RCPI and HSE Clinical lead - Prevention of Healthcare-associated Infection
- Ms Mairead Holland, Infection Control, Adelaide & Meath Hospital, incorporating the National Children's Hospital (AMNCH), Dublin 24
- Professor Jonathan Hourihane, Cork University Hospital, Cork
- Dr Paul Kelly, Consultant in Emergency Medicine, Waterford Regional Hospital, Waterford
- Dr Catherine Lynch on behalf of Dept. Public Health, HSE-Southeast
- Dr Maureen Lynch, Consultant Microbiologist, Mater Misericordiae University Hospital, Dublin 7
- Dr Brian Marsh, Chairperson Division of Anaesthesia, Mater Misericordiae University Hospital, Dublin 7
- Dr Patricia Mc Donald, Dr Howard Johnson, Dr Mary Ward on behalf of Dept. Public Health, HSE East
- Professor Philip Murphy, Consultant in Medical Microbiology, Adelaide & Meath Hospital, incorporating the National Children's Hospital (AMNCH), Dublin 24, Dublin 24
- Dr Diarmuid O'Donovan on behalf of the Dept. Public Health, HSE-West
- Mr James Powell, Surveillance Scientist, Mid-Western Regional Hospital, Limerick and member of the Scientific Advisory Committee (HPSC)
- Mr Brian Power on behalf of Pre-Hospital Emergency Care Council.

MEMBERS OF THE WORKING GROUP

- Dr Darina O'Flanagan, Director, Health Protection Surveillance Centre (Chair)
- Ms Nellie Bambury, Infection Prevention Society (2006 to 2010)
- Professor Karina Butler, Faculty of Paediatrics and Royal College of Physicians of Ireland
- Professor Mary Cafferkey, Consultant Microbiologist, Director of the Irish Meningococcal and Meningitis Reference Laboratory (to 2010) and Royal College of Surgeons (RCSI)
- Dr Suzanne Cotter, Specialist in Public Health Medicine, Health Protection Surveillance Centre
- Ms Paula McElligott, Infection Prevention Society (up to 2005)
- Dr Dominick Natin, Faculty of Occupational Medicine, Royal College of Physicians of Ireland (up to 2005)
- Dr Dermot Nolan, Irish College of General Practitioners (up to 2005)
- Dr Emer O'Connell, Specialist in Public Health Medicine, Faculty of Public Health Medicine, Royal College of Physicians of Ireland
- Dr Piaras O'Lorcain, Surveillance Scientist, Health Protection Surveillance Centre
- Dr Fiona Ryan, Specialist in Public Health Medicine, Faculty of Public Health Medicine, Royal College of Physicians of Ireland

Clinical Subgroup

- Professor Karina Butler, Faculty of Paediatrics, Royal College of Physicians of Ireland (Chair)
- Dr Sinead Donohue, SpR in Public Health Medicine, Health Protection Surveillance Centre, (Chair 2011)
- Dr William Casey, Consultant Anaesthetist, Our Lady's Children's Hospital, Crumlin, Dublin
- Dr Suzanne Cotter, Specialist in Public Health Medicine, Health Protection Surveillance Centre
- Dr Brian Marsh, Consultant Anaesthetist, Mater Misericordiae University Hospital, Dublin
- Professor Owen Smith, Consultant Haematologist, Our Lady's Children's Hospital, Crumlin, Dublin
- Ms Aoibheann O'Malley, Health Protection Surveillance Centre, was administrative secretary to the group

ACKNOWLEDGEMENTS

The Bacterial Meningitis Subcommittee of the Scientific Advisory Committee of HPSC wish to thank the following groups for sharing their work and experience in relation to research, policy, and guidance:

- Royal College of Physicians of Ireland
    - The Faculty of Paediatrics
    - The Faculty of Public Health Medicine
    - The Faculty of Occupational Medicine
    - National Immunisation Advisory Committee, RCPI
- Our Lady's Children's Hospital, Crumlin, Dublin
- Children's University Hospital, Temple Street, Dublin
- The Irish Meningococcal and Meningitis Reference Laboratory, Children's University Hospital, Temple Street, Dublin
- The National Pneumococcal Pilot Typing Project at the Department of Clinical Microbiology, RCSI Education and Research Centre, Beaumont Hospital, Dublin and the Children's University Hospital, Temple Street, Dublin
- The Irish Society of Clinical Microbiologists
- HSE Departments of Public Health
- The Irish College of General Practitioners
- Infection Prevention Society (Ireland) (formerly the Infection Control Nurses Association)
- Infectious Diseases Society of Ireland
- Intensive Care Society of Ireland
- Department of Health
- Meningitis Research Foundation
- Meningitis Trust

Guidelines, Policies and Standard Operating Procedures Reviewed

In developing the guidance the subcommittee reviewed existing guidelines that were in use both nationally and internationally. The Subcommittee would like to acknowledge in particular the information provided in guidance documents on bacterial meningitis from the UK (HPA), Scotland, Australia, the US (CDC, AAP, APLS,) and ECDC as well as HSE Departments of Public Health and hospitals, including;

- Guidance for the early clinical and public health management of meningococcal disease in Australia. Australian Government Department of Health and Ageing, October 2007[1]
- Public health management of sporadic cases of invasive meningococcal disease and their contacts. Stockholm: ECDC; 2010 [2]
- Guidance for public health management of meningococcal disease in the UK. Health Protection Agency Meningococcus Forum. Updated 2011[3]
- HPA interim guidance for the public health management of clusters of serious pneumococcal disease in closed settings (2008) [4]

Additional sources of information included;

- **Meningitis Research Foundation (UK) and British Infection Society** - documents
- **Scottish Intercollegiate Guidelines Network (SIGN) -** "*Management of invasive meningococcal disease in children and young people*" [5]
- **National Institute for Health and Clinical Excellence -** "*Bacterial meningitis and meningococcal septicaemia in children*"(2010) [6]

TERMS OF REFERENCE

1. To review the guidance on the prevention and control of bacterial meningitis and invasive meningococcal disease in Ireland including:
   - Management to reduce mortality and morbidity, during the pre-admission and continuing care phases
   - Investigation of suspected cases
   - Case definitions
   - Public health action after a single case
   - Management of clusters.

2. To review the epidemiology of bacterial meningitis and invasive meningococcal disease and to provide advice as required to the RCPI National Immunisation Advisory Committee on the use of vaccines to prevent cases of meningitis/encephalitis.

3. To act as a source of expert advice on meningitis and invasive meningococcal disease when required.

4. To co-ordinate with the Vectorborne Sub-Committee of the Scientific Advisory Committee of the Health Protection Surveillance Centre to ensure consistency of guidance especially in relation to arboviral disease. (Specific guidance in relation to the surveillance and control of viral meningitis and encephalitis is being developed separately).

FOREWORD

The majority of notifications under the heading of "bacterial meningitis" are caused by *N. meningitidis*. Invasive meningococcal disease is a serious condition with high morbidity and significant mortality. In 1999, the Department of Health issued guidance on management of meningococcal disease - Working Group Report on Bacterial Meningitis and Related Conditions, 1999.

The Scientific Advisory Committee of HPSC have now reviewed and updated the 1999 guidelines. This report describes the epidemiology of meningococcal disease and other bacterial diseases causing meningitis and provides updated information.

Since the original Working Group Report on Bacterial Meningitis and Related Conditions, 1999, marked changes in the epidemiology of meningococcal disease have occurred with a decline in the incidence of serogroup C meningococcal disease (influenced predominantly by the introduction of the MenC vaccination programme in 2000) and also a decline in serogroup B meningococcal disease.

A booster dose of the *Haemophilus influenzae* type b vaccine (Hib) was recommended as part of a Hib catch-up campaign for children under 4 years of age in November 2005, following recognition of waning immunity in this population. In September 2006, a Hib booster at 12 months of age was introduced to the routine childhood immunisation programme. This public health measure ensures that Irish children have additional protection against this serious disease.

The recent introduction (2008) into the childhood immunisation programme of the pneumococcal conjugate vaccine (PCV7) has contributed to a decrease in pneumococcal disease in the paediatric population. The benefits of this childhood vaccination have also been seen in the adult population, with a decline in the incidence of invasive disease caused by those serotypes included in the vaccine. In December 2010, an expanded valency pneumococcal vaccine (PCV13) was introduced.

The guidelines include practical guidance in relation to the management of sporadic cases, clusters, chemoprophylaxis and vaccination. The guidelines are necessarily general and those using the guidelines are advised to seek expert advice on the management of cases (from clinical microbiologists, infectious disease physicians, public health physicians) if and as required.

The information provided in this document is based upon the best available evidence at the time of writing.

The guidance can be adapted depending on local circumstances and risk assessment of each suspected case or situation.

Dr Darina O'Flanagan
Chair, Bacterial Meningitis Sub-committee, Scientific Advisory Committee, HPSC

KEY RECOMMENDATIONS

Summary

- The most frequent causes of bacterial meningitis worldwide include *Neisseria meningitidis* (meningococcus), *Streptococcus pneumoniae* (pneumococcus) and *Haemophilus influenzae* type b (Hib).
- In neonates (children younger than 28 days), the most common causative organisms are *Streptococcus agalactiae* (Group B streptococcus), *Escherichia coli*, *S. pneumoniae* and *Listeria monocytogenes*.[6]
- Serious meningococcal disease most commonly presents as meningitis or septicaemia or as a combination of these two syndromes. Meningococcal disease is the leading infectious cause of death in early childhood, making its control a priority for clinical management (as well as public health surveillance and control).
- The majority of cases of bacterial meningitis and invasive meningococcal disease notified in this country occur in children under 10 years of age.
- The epidemiology of bacterial meningitis and invasive meningococcal disease in Ireland has changed dramatically in the past two decades following the introduction of vaccines to control Hib, serogroup C meningococcus and some types of pneumococcus.
- Tuberculosis meningitis management is not discussed in this document but has been described in the HPSC publication '*Guidelines on the Prevention and Control of Tuberculosis in Ireland, 2010*'.
- Under Infectious Disease Regulations S.I. No. 707/2003 - Infectious Diseases (Amendment) (No. 3) Regulations 2003 [7] clinicians and laboratory directors are required to notify the medical officer of health (in Departments of Public Health) immediately upon suspicion that a patient has bacterial meningitis or meningococcal septicaemia. Other notifiable diseases causing meningitis are also notifiable as soon as possible.

Pre-admission Management

- A presumptive diagnosis of bacterial meningitis is a medical emergency and immediate referral to hospital is required.
- Meningococcal septicaemia has a higher mortality rate than meningococcal meningitis. Septicaemia is often characterised by a rapidly evolving petechial or purpuric rash. In the early stage of development the rash may blanch with pressure thus resembling a viral rash, or it may be absent, or may be atypical. Sometimes it may consist only of a few haemorrhagic spots located in an occult site such as the groin or feet.
- Meningococcal disease may present with clinical features that are indistinguishable from those associated with other acute self-limited systemic illness. Symptoms such as pallor, altered mental state or limb pain should raise suspicion of meningococcal disease.
- "Red flag symptoms" include confusion, leg pain, photophobia, rash and neck pain/stiffness.
- Health care providers should ensure that all patients with an acute systemic febrile illness, particularly children, can be reassessed without delay if their condition deteriorates.
- Doctors should be encouraged to review the situation within 4–6 hours if early meningococcal disease cannot be ruled out at the first assessment (safety net approach).
- All GPs should carry benzylpenicillin in their surgeries and emergency bags, and should be ready to administer it without delay to patients with a systemic febrile illness and a petechial or purpuric rash. Ceftriaxone or cefotaxime are suitable alternatives if available.

Hospital Management of the Patient with Community Acquired Bacterial Sepsis/ Meningitis including Meningococcal Infection

- The development of signs suggestive of acute sepsis and/or meningitis is a medical emergency and mandates prompt intervention.
- Management priorities differ depending on the clinical presentation i.e. that of severe sepsis with or without associated meningitis, or that of meningitis.
- If a patient has clinical signs or symptoms suggestive of invasive meningococcal disease (meningitis or septicaemia) parenteral antibiotics should be administered without delay.

- If there are no signs of meningeal irritation or meningitis is not suspected, lumbar puncture is not required on initial assessment.
- Consider lumbar puncture when meningitis is suspected only if appropriate (the patient has no signs of haemodynamic, respiratory instability, is neurologically stable, no signs of increased intracranial pressure, no sepsis in the area through which the needle will pass, no evidence of coagulopathy).
- Treatment should not be delayed while awaiting results of diagnostic tests.
- Collect blood samples as soon as possible for PCR and culture, and full blood count.
- If petechiae or frank bleeding is evident, formal coagulation studies should be undertaken.
- In patients with meningococcal infection, treatment to eradicate nasopharyngeal carriage is required.
- The department of public health (medical officer of health) should be notified immediately so that the appropriate public health response can be determined.

Surveillance

Clinicians and laboratories are legally required to:

- Notify all cases of suspected bacterial meningitis, invasive meningococcal or Hib disease to the local public health department immediately without waiting for microbiological confirmation.
- Notify all cases of pneumococcal meningitis upon microbiological confirmation.

Departments of public health should:

- Undertake enhanced surveillance on all cases.
- Implement prompt public health interventions as appropriate.
- Monitor disease incidence and trends.
- Evaluate public health interventions and policies.

Surveillance data are reviewed regularly at national and local level.

Epidemiology and surveillance of bacterial meningitis in Ireland

- The incidence of bacterial meningitis and invasive meningococcal disease peaked in 1999, at 16.2 cases per 100,000. The current incidence is 4.3 cases per 100,000 (2010 data).
- Meningococcal disease continues to account for the majority of bacterial meningitis notifications.
- *Neisseria meningitidi*s serogroup B is the most common infecting serogroup in Ireland.
- MenC and Hib vaccines have had a major impact in reducing morbidity and mortality due to Men C and Hib respectively.
- Meningitis due to *Streptococcus pneumoniae* is the second most common form of bacterial meningitis notified.
- There has been a decline in pneumococcal disease following the recent (2008) introduction of pneumococcal conjugate vaccine (PCV) to the childhood immunisation programme.

Laboratory Diagnosis

- Antibiotic therapy should not be delayed while initiating or awaiting results of diagnostic tests.

Diagnostic tests used include:

- Culture for pathogens associated with meningitis from normally sterile sites i.e. blood culture+/- CSF examination and culture.
- Specific PCR tests are available at the Irish Meningococcal and Meningitis Reference Laboratory (IMMRL) to detect *N. meningitidis, S. pneumoniae, H. influenzae* and group B streptococcal nucleic acid (in blood and CSF samples).

Additional tests that may be useful include:

- Direct microscopy and demonstration of intracellular gram negative diplococci (GNDC) in scrapings from a petechial or purpuric lesion.
- Culture for *N. meningitidis* from non-sterile site (throat, eye) is recommended as an adjunct to other samples as it may yield an isolate for epidemiological typing, however, this is not a diagnostic test.
- Serological tests for antibody to *N. meningitidis* have been utilised in the past but are now rarely used.
- In the case of isolates of *N. meningitidis* and *H. influenzae,* strain differentiation (phenotyping, molecular typing, and gene sequencing) is performed at the Irish Meningococcal and Meningitis Reference Laboratory (IMMRL). In addition, epidemiological typing and antimicrobial susceptibility testing of invasive isolates of group B streptococcus is available at the IMMRL.

Epidemiological typing and detailed antimicrobial susceptibility testing of pneumococcal isolates is performed by the Pneumococcal Pilot Typing Project (collaborative project between the RCSI Education and Research Centre, Department of Clinical Microbiology in Beaumont Hospital and CUH Temple St, and HPSC).

Notification of any case of invasive disease causing meningitis should have regard to agreed case definitions under the infectious disease regulations.

Isolation of the organism or a positive PCR test are the most commonly reported laboratory tests used to confirm disease.

Public Health Management of Sporadic Cases of Invasive Meningococcal Disease

- Nasopharyngeal carriage of *N. meningitidis* is common; with some 10% of the population carrying meningococci at any given time.
- There is a well established increased risk of further cases among the household contacts, and intimate kissing and sexual contacts of a case of meningococcal disease.
- Settings where the increased risk is lower than that of household contacts include those in very close contact with a case after the onset of symptoms, and in childcare facilities.
- When sporadic cases occur in schools and third level institutions, specific risk assessment is required to determine which contacts, if any, are at increased risk.
- The public health response to meningococcal disease includes: identification of close contacts, arranging appropriate chemoprophylaxis and provision of appropriate information.
- The main reason for giving chemoprophylaxis is to eliminate meningococci from any carrier who may be in the network of contacts of each index case. This reduces the risk to other susceptible individuals in the network, protecting them from acquiring the meningococcal strain from the carrier and possibly developing invasive disease.
- Depending on the serogroup of the index case, vaccination with MenB, MenC or MenACWY vaccine may be recommended for close contacts.
- Throat swabs have no role in the public health management of contacts of invasive meningococcal disease.

Public Health Management of Cases of Invasive Haemophilus Influenzae Type b (Hib) or Pneumococcal disease

- Chemoprophylaxis is recommended for contacts of a case of invasive Hib disease only when there is another at risk individual in the contact network (see relevant section).
- Chemoprophylaxis is not normally recommended for contacts of cases of sporadic pneumococcal meningitis (unless clusters of disease) (see relevant section).

Management of clusters of invasive meningococcal disease

- The objective of public health management of outbreaks is to interrupt the transmission of disease and prevent further cases occurring.
- Clusters/outbreaks may be based in an institution or organisation or community.

Chemoprophylaxis of contacts of invasive meningococcal disease

- There is evidence that microbiological clearance of meningococci follows administration of appropriate antibiotics.
- The decision to provide chemoprophylaxis is based on a risk assessment following the notification of each case.
- Three antibiotics (rifampicin, ciprofloxacin, ceftriaxone) are currently recommended in Ireland for chemoprophylaxis of meningococcal disease; each agent has advantages and disadvantages and is the preferred agent in specific circumstances.
- Rifampicin can be used in all age groups and for the majority of the population (except for those with contraindications). For pregnant women and women on systemic hormonal contraceptives it is an alternative option.
- Ciprofloxacin can be used in all age groups and for the majority of the population (except for those with contraindications). It is the antibiotic of choice for those on the oral contraceptive pill. For pregnant women ciprofloxacin is the preferred option.
- Ceftriaxone is the alternative option for pregnant women or lactating women.

Infection Control Measures

- *N. meningitidis* is transmitted from person-to-person by aerosols, droplets or direct contact with respiratory secretions from a person carrying the organism.
- Suspect/confirmed cases should ideally be placed in a single room for the first 24 hours following initiation of treatment.
- After 24 hours of appropriate antibiotic treatment individuals with meningococcal disease are considered to be no longer infectious.
- HCWs should wear surgical masks when in close contact with an infectious patient for the first 24 hours after initiation of treatment.
- Pre-exposure vaccination may be considered for HCWs at increased risk of exposure (e.g. laboratory workers handling specimens (see Chapter 10 for more detail).

GLOSSARY OF ACRONYMS

ASIR	Age Specific Incidence Rate
CDC	Centers for Disease Control and Prevention (US)
CSF	Cerebrospinal fluid
DOH	Department of Health
DPH	Director of Public Health
ECDC	European Centre for Disease Prevention and Control
EU	European Union
FBC	Full blood count
HCW	Healthcare worker
Hib	*Haemophilus influenzae* type b
HPA	Health Protection Agency (UK)
HPSC	Health Protection Surveillance Centre
HSE	Health Service Executive
IMD	Invasive Meningococcal Disease
IMMRL	Irish Meningococcal and Meningitis Reference Laboratory
LHO	Local Health Office
IPD	Invasive Pneumococcal Disease
LP	Lumbar puncture
MenC	*N. meningitidis* serogroup C conjugate vaccine
MoH	Medical Officer of Health
NIAC	National Immunisation Advisory Committee
PCV	Pneumococcal conjugate vaccine
RCPI	Royal College of Physicians of Ireland
RCT	Randomised control trial
SPHM	Specialist in Public Health Medicine
SMO	Senior Medical Officer
WHO	World Health Organization

CHAPTER 1. INTRODUCTION

Bacterial meningitis is an infection of the surface membranes of the brain (meninges) by bacteria that have usually travelled there from mucosal surfaces via the bloodstream. In children and young people aged 3 months or older, the most frequent causes of bacterial meningitis include *Neisseria meningitidis* (meningococcus), *Streptococcus pneumoniae* (pneumococcus) and *Haemophilus influenzae* type b (Hib). These organisms are normal commensals of the nasopharynx and can cause invasive disease when acquired by a susceptible person. *N. meningitidis* continues to account for the majority of cases of bacterial meningitis notified in Ireland. In neonates (children younger than 28 days), the most common causative organisms of bacterial meningitis are *Streptococcus agalactiae* (Group B streptococcus), *Escherichia coli*, *S. pneumoniae* and *Listeria monocytogenes*.[6]

Most bacterial colonisations on mucosal surfaces are asymptomatic but occasionally the organism may invade the bloodstream to cause disease. Serious meningococcal disease most commonly presents as bacterial meningitis or septicaemia, or as a combination of the two syndromes. Meningococcal disease is the leading infectious cause of death in early childhood, making its control a priority for clinical management (as well as public health surveillance and control).

The epidemiology of bacterial meningitis in Ireland has changed dramatically in the past two decades following the introduction of vaccines to control Hib disease, serogroup C meningococcus and some types of pneumococcus. Development of vaccines against *N. meningitidis* group B is in progress and when licensed will be important tools in prevention of what is now the most common cause of bacterial meningitis in Ireland.

These guidelines do not discuss management of tuberculosis meningitis which has been included in the HPSC publication '*Guidelines on the Prevention and Control of Tuberculosis in Ireland, 2010*'. Meningitis caused by other bacteria is discussed in the epidemiology section of this document. Public health measures relating to Hib and pneumococcal disease are outlined in the document but public health measures for other bacteria causing meningitis are not discussed in this document as public health measures are not usually required for such diseases. Meningitis or encephalitis caused by viruses and related guidance is under review and will be presented in a separate document.

Under the Infectious Disease Regulations S.I. No. 707/2003 - Infectious Diseases (Amendment) (No. 3) Regulations 2003 [7] clinicians and laboratory directors are required to notify the Medical Officer of Health (MoH) immediately upon suspicion that a patient has meningitis or meningococcal septicaemia. Other notifiable diseases causing meningitis are also notifiable as soon as possible.

CHAPTER 2. PRE-ADMISSION MANAGEMENT

Key points

- A presumptive diagnosis of bacterial meningitis is a medical emergency and immediate referral to hospital is required.
- Meningococcal septicaemia has a higher mortality rate than meningococcal meningitis. Septicaemia is often characterised by a rapidly evolving petechial or purpuric rash that does not blanch under pressure. However, in the early stage of development the rash may blanch with pressure thus resembling a viral rash, or it may be absent, or may be atypical. If present it may consist only of a few haemorrhagic spots located in a place such as the groin or feet.
- Meningococcal disease may have clinical features not normally encountered in children with acute systemic self limiting febrile illnesses.
- "Red flag symptoms" include confusion, leg pain, photophobia, rash and neck pain/stiffness.
- Health care providers should ensure that any patient with a systemic febrile illness, particularly a child, can be reassessed without delay if their condition deteriorates.
- Doctors should be encouraged to review the situation within 4-6 hours if early meningococcal disease cannot be ruled out at first assessment.
- All GPs and advanced paramedics should have benzylpenicillin available when attending patients and should be ready to administer it without delay to patients with a systemic febrile illness and a petechial or purpuric rash. Ceftriaxone or cefotaxime are suitable alternatives if available.

2.1 Introduction

Meningococcal disease usually presents as meningitis or septicaemia, or a combination of the two. Septicaemia, with or without meningitis, can be particularly severe and is associated with a considerably greater mortality rate than meningococcal meningitis without bloodstream infection.[8]

Meningococcal septicaemia can have a fulminant and rapidly fatal course. The development of signs suggestive of acute sepsis and/or meningitis **is a medical emergency** and mandates prompt intervention. Management priorities differ depending on the clinical presentation i.e. that of severe sepsis with or without associated meningitis, or that of meningitis.

Acute meningococcal disease, the most common cause of life threatening infection in healthy children and young adults, commonly presents as severe sepsis and/or meningitis. Rarely, other forms of invasive meningococcal infection are encountered. The overall mortality rate for meningococcal infection typically ranges from 3-10%, but can reach as high as 20-40% in severe sepsis/meningitis (see Chapter 5 for further detail). Meningococcal infection remains the most common cause of bacterial meningitis in Ireland.

The ***speed*** with which meningococcal infections are recognized and treated is critical to achieving a successful outcome and clinical suspicion alone mandates treatment. **If meningococcal infection is suspected, administration of benzylpenicillin by the GP or advanced paramedic may be life-saving and is strongly recommended**. Although results of studies of the benefit of pre-admission antibiotics have been inconsistent, this has variably been attributed to their retrospective nature and confounding factors such as illness severity (those most severely ill may be more likely to receive antibiotics).[9,10]

2.2 Clinical presentation of invasive meningococcal disease

The most characteristic feature of meningococcal septicaemia is a haemorrhagic (i.e. petechial or purpuric) rash that does not blanch under pressure. **However, a rash is not always present, particularly in the early stages.** In

the early stage of development the rash may blanch with pressure thus resembling a viral rash. The rash can appear rapidly on any part of the body including the palms and soles. The petechial rash presents as discrete 1 to 2 mm in diameter lesions that may proceed to form larger ecchymotic lesions. The rash commonly appears in clusters in areas where pressure occurs from elastic in underwear and stockings. The rash may go unnoticed unless the acutely unwell patient with a systemic febrile illness is completely undressed so that a thorough search for a haemorrhagic rash can be undertaken.

Less commonly, the rash has a maculopapular appearance, with the discrete pink macules or papules blanching under pressure. They may progress to become haemorrhagic and nonblanching later or fade away.[10]

Additional features that should alert clinicians to the possibility of meningococcal infection include:

- an unwillingness to interact or make eye contact
- an altered mental state, or
- pallor despite a high temperature.[11]

A UK study published in 2006 [12] reported on the variety of clinical presentations found among children under 16 years of age diagnosed with meningococcal disease. The authors found that:

- leg pain
- cold extremities
- and abnormal skin colour

were frequently seen in the first 12 hours of meningococcal disease (median onset 7-12 hours).

More recently in 2011 the authors reported five "red flag symptoms":

- confusion
- leg pain
- photophobia
- rash and
- neck pain/stiffness.

In this study cold hands and feet had limited diagnostic value, while headache, and pale colour did not discriminate meningococcal disease in children.[13]

In contrast, the classic clinical features:

- haemorrhagic rash
- meningism, and
- impaired consciousness were

relatively late signs (median onset 13-22 hours).[12,14]

These early features should therefore be sought to aid the early recognition of invasive meningococcal disease in children less than 16 years of age. These symptoms and signs however, can be non-specific and some may be present with other bacterial and viral infections including self-limiting viral illnesses.

- Doctors should be encouraged to review the situation within 4–6 hours if early meningococcal disease cannot be ruled out at the first assessment.[12,14]

If a GP decides that a patient with a non-specific febrile illness does not require referral to a hospital, the GP should advise the carer to keep the patient under frequent and regular review. Any deterioration or development of rash should trigger contacting the GP again or going immediately to a hospital emergency department. Rarely, meningococcal disease may present as conjunctivitis. Primary meningococcal conjunctivitis may be associated with invasive disease and should be treated systemically.[15]

2.3 Early antibiotic treatment for suspected bacterial septicaemia/meningitis

It is imperative that antibiotic therapy be commenced early if deaths from meningococcal septicaemia are to be avoided. Immediate administration of benzylpenicillin to suspected cases of meningococcal septicaemia by general practitioners was associated with reduced mortality in three retrospective studies in England.[10,14,16] When the studies were aggregated (487 patients), it was calculated that those not given parenteral penicillin before hospital admission were twice as likely to die than those given penicillin.[17] The greatest benefit of parenteral penicillin was seen in those who were most ill i.e. those with a haemorrhagic rash.[14]

For optimal benefit, benzylpenicillin should be given intravenously. However, if general practitioners or advanced paramedics are unable to access the intravenous route, it is appropriate to administer benzylpenicillin by the intramuscular route.[18]

Benzylpenicillin should be withheld only if an individual has a proven history of penicillin anaphylaxis.[18] In the extremely rare case of history of anaphylactic reaction to penicillin, the highest priority is to get the patient to hospital.

A clear history of proven penicillin anaphylaxis is a contraindication to use of penicillin or cephalosporins.

Recommendation

All general practitioners or advanced paramedics should have benzylpenicillin available in their surgeries and emergency bags and should be ready to administer it without delay to a patient with an acute systemic febrile illness and a petechial or purpuric rash. It is particularly important that this should be done if a person shows signs of sepsis or decreased level of consciousness.

Doses of antibiotic for suspected cases of meningococcal disease
Benzylpenicillin:
Adults or children aged 10 years or over: 1200 mg
Children aged 1-9 years: 600 mg
Children aged < 1 year: 300 mg

GPs or advanced paramedics are not expected to carry an alternative antibiotic to benzylpenicillin. However, if available, a third generation cephalosporin (ceftriaxone 80 mg/kg/dose, max 2g or cefotaxime 50 mg/kg/dose, max 2g) can be used and is an acceptable alternative to benzylpenicillin for the empirical treatment of suspected meningococcal disease prior to transfer to hospital.

Alternative to benzylpenicillin if available:
Ceftriaxone 80 mg/kg (up to 2g) IM or IV (all ages)
OR
Cefotaxime 50 mg/kg (up to 2g) IM or IV (all ages)

2.4 Immediate transfer to hospital

GPs should organise immediate transfer of the patient to hospital. The ambulance service needs to be informed of the immediate and critical nature of the transfer.

Recommendation

It is strongly recommended that any patient with an acute systemic febrile illness be referred immediately to hospital if any of the following are present:

- a haemorrhagic rash
- an impaired level of consciousness
- signs of meningeal irritation
- clinical features not normally expected in children with acute self limiting systemic febrile illnesses or
- the patient is a close contact of someone who was recently diagnosed as having meningococcal disease even if the current patient received clearance antibiotics.

GPs or advanced paramedics should telephone and inform the emergency department and clinician at the referral hospital of the patient's impending arrival so that delays in treatment are minimal. Clinical notes accompanying the patient should inform the hospital clinician about antibiotics that have been administered (and dose).

CHAPTER 3: HOSPITAL MANAGEMENT

Key points

- The development of signs suggestive of acute sepsis and/or meningitis is a medical emergency and mandates prompt intervention.
- Management priorities differ depending on the clinical presentation i.e. that of severe sepsis with or without associated meningitis, or that of meningitis.
- If a patient has clinical signs or symptoms suggestive of invasive meningococcal disease (meningitis or septicaemia) they should be given parenteral antibiotics immediately.
- All patients should ideally be placed in isolation in a single room for the first 24 hours of treatment.
- If there are no signs of meningeal irritation or meningitis is not suspected, lumbar puncture is not required on initial assessment.
- Consider lumbar puncture for a person in whom meningitis is suspected only if there are no contraindications (the patient is neurologically stable and there are no signs of increased intracranial pressure or other contraindications).
- Treatment should not be delayed while awaiting results of diagnostic tests.
- Collect blood samples as soon as possible for PCR and culture, and full blood count.
- If petechiae or frank bleeding is evident, formal coagulation studies should be undertaken.
- The patient should be given chemoprophylaxis when able to take oral medication and before discharge from hospital, unless the disease had already been treated with ceftriaxone.
- The department of public health (medical officer of health) should be notified immediately so that a public health response can be determined.
- Hospitals and departments of public health should have local protocols for dealing with chemoprophylaxis including out-of-hours.

3.1 Introduction

The development of signs suggestive of **acute sepsis and/or meningitis is a medical emergency** and mandates prompt intervention. Management priorities differ depending on the clinical presentation i.e. that of severe sepsis with or without associated meningitis, or that of meningitis.

In both scenarios it is imperative that appropriate antimicrobials are given as soon as the diagnosis of sepsis

Acute meningococcal disease, the most common cause of life threatening infection in healthy children and young adults, commonly presents as severe sepsis and/or meningitis. Rarely, other forms of invasive meningococcal infection are encountered. The overall mortality rate for meningococcal infection is approximately 3-10%, but can reach as high as 20-40% in severe sepsis/meningitis. In a review of 407 children in Ireland, with meningococcal infection who survived to hospital admission between 1995 and 2000, the overall mortality rate was 3.6-4.8%.[19] From 1999 – 2005, the overall case fatality rates for meningococcal infection in Ireland ranged from 3-5% with somewhat higher rates observed in adults (7-8%).[20]

Despite the efficacy of the MenC vaccine, meningococcal infection remains the most common cause of bacterial meningitis in Ireland. Serogroup B isolates account for the overwhelming majority of cases now diagnosed in Ireland. The ***speed*** with which meningococcal infections are recognized and treated is critical to achieving a

successful outcome and clinical suspicion alone mandates treatment. If meningococcal infection is suspected, administration of benzylpenicillin by the GP may be life-saving [21] and is recommended. Although results of studies of the benefit of pre-admission antibiotics have been inconsistent,[22-24] this has variably been attributed to their retrospective nature and confounding factors such as by illness severity (those most severely ill may be more likely to receive antibiotics).[9]

Overall, pneumococcal infection is currently the second most common form of bacterial meningitis and the most common form of bacterial meningitis in the elderly. The incidence of Hib meningitis declined steeply following the introduction of this Hib vaccine.

The following guidelines are presented in sections - evaluation, management of each individual case (sepsis or meningitis):

Section A
Clinical evaluation for suspected bacterial meningitis or meningococcal septicaemia

Section B

Guidelines for the management of the haemodynamically stable patient with meningitis

Section C

Guidelines for the management of community acquired bacterial sepsis/meningitis, including meningococcal infection

SECTION A

Clinical evaluation for suspected bacterial meningitis or meningococcal septicaemia

History	Examination	Suspect severe sepsis if:	Bad prognostic signs include:
➢ Headache/photophobia ➢ Neck and back stiffness ➢ Vomiting/off feeds (infant) ➢ Lethargy/altered consciousness/altered or inappropriate behaviour ➢ Irritability (infant) ➢ Fever ➢ Rash (meningococcal) ➢ Reduced urine output (or dry nappy reported by parent) Classic clinical features of meningococcal disease can appear relatively late in the illness. Early clinical features include: ➢ Leg pains ➢ Cold hands & feet ➢ Abnormal skin colour [25] **Be aware:** *The rash in early meningococcal infection is typically a non-blanching erythematous macular rash. However, in the early stages it may blanch with pressure.*	➢ Ensure **Airway** is clear ➢ **Breathing** pattern is satisfactory ➢ **Circulation** pulse rate and volume, BP, capillary refill ➢ Pyrexia ➢ Floppy/abnormal tone (infant) ➢ Skin changes ➢ Characteristic rash (meningococcal) ➢ Meningism/bulging fontanelle (infant) ➢ Decreased level of consciousness ➢ Signs of raised ICP: • fluctuating consciousness, • ↑BP & relative bradycardia • unequal, dilated or poorly responsive pupils • focal neurological signs • seizures, abnormal posture • papilloedema (late sign) ➢ Other babies may have floppy abnormal tone ➢ Older children/adults- may appear aggressive or have inappropriate behaviour.	➢ Tachycardia ➢ Tachypnoea ➢ Rapid, low volume pulse ➢ Slow capillary refill time (>2 sec) ➢ Skin to core temperature difference ➢ Evolving characteristic rash ➢ Oliguria (<1ml/kg/hr) ➢ Hypotension (late sign) Suspect cerebral oedema if ➢ Na <135mmol/L and Signs of raised ICP (see column to left) or ➢ Na<130mmol/l without clinical signs.	➢ Differential skin/core temp > 3^{0}C (children) ➢ Systolic BP < 85 mm Hg (age > 4yrs) Systolic BP < 75 mm Hg (age < 4yrs) ➢ White cell count <10.0 x10^{9}/L ➢ Metabolic acidosis ➢ Base deficit > -5.0mmol/l **or** serum lactate > 5.0 mmols/l or rising ➢ Coagulopathy ➢ Rapidly evolving characteristic rash ➢ Altered conscious state ➢ Beware meningococcal sepsis without signs of meningitis (meningism) **These patients constitute a very high risk group and warrant vigilant monitoring and early aggressive therapy and importantly constant clinical re-evaluation to see if treatment goals are achieved.**

Monitoring in Emergency Department: Cardiac, Non-invasive BP, Pulse Oximetry, Core Temperature

SECTION B
Guidelines for the MANAGEMENT OF THE HAEMODYNAMICALLY STABLE PATIENT WITH meningitis

Summary of management approach
1. ABC management ➢ Assess and maintain **airway** and **breathing** as required ➢ Administer 100% O_2 at 15 L/min ➢ Assess **circulation** and secure vascular access (intravenous or intraosseous)
2. Summon help, alert ICU team
3. Order first dose antibiotics to be drawn up
4. Draw bloods stat
5. Give dexamethasone before or at the time of antibiotics
6. Give IV/IO antibiotics without undue delay
7. Commence IV fluids
8. Evaluate for presence of cerebral oedema
9. If cerebral oedema / ↑ICP → intensive care with guided neurological care
10. Consider intubation
11. Lumbar puncture should be carried out if the patient is haemodynamically stable and there are no contraindications
12. Reassess clinically
13. If meningococcal infection suspected obtain throat swab and/or pernasal swab
14. Consider further consultation: (microbiology/neurology/nephrology/infectious diseases)
15. Notify public health and infection Control. Ensure contact chemoprophylaxis and information as per agreed protocol.

<table>
<tr><th colspan="3">MANAGEMENT OF THE HAEMODYNAMICALLY STABLE PATIENT WITH meningitis</th></tr>
<tr><th>ACTION</th><th>NOTES</th><th>GOALS</th></tr>
<tr><td>1. ABC MANAGEMENT

ADMINISTER 100% O_2 at 15 L/ MIN</td><td>Assess and maintain airway and breathing as required

Assess circulation and secure vascular access (intravenous [IV] or intraosseous [IO])
IV access as large as practical, ideally 2, or intraosseous</td><td>Maintain O_2 saturation > 94%

Establish secure access to permit fluid and medication delivery</td></tr>
<tr><td>2. SUMMON HELP, alert ICU team</td><td>Ideally >1 doctor should be present to optimise initial management</td><td>Facilitate resuscitation

Permit early intubation if necessary</td></tr>
<tr><td colspan="2">3. ORDER FIRST DOSE ANTIBIOTICS TO BE DRAWN UP while work proceeds

<table>
<tr><th rowspan="2">ANTIBIOTIC</th><th colspan="4">AGE</th></tr>
<tr><th>0 - 1 mos</th><th>1 – 2 mos</th><th>> 2 mos</th><th>Max Dose (Adult dose)</th></tr>
<tr><td>Cefotaxime or</td><td>50 mg/kg</td><td>50 mg/kg or</td><td>50 mg/kg or</td><td>2g</td></tr>
<tr><td>Ceftriaxone</td><td>Not in neonates</td><td>80 mg/kg</td><td>80 mg/kg</td><td>2g</td></tr>
<tr><td>Amoxicillin*</td><td>100 mg/kg</td><td>50 mg/kg</td><td></td><td>2g</td></tr>
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<tr><td>Vancomycin</td><td></td><td>15 mg/kg</td><td>15 mg/kg</td><td>10-15 mg/kg (max 1g)</td></tr>
</table>
*Patients under two months require specific Listeria and gram-negative organism cover

In severe penicillin allergy Meropenem 40 mg/kg/dose (max 2g) can be used

Ceftriaxone
• Is contraindicated in newborns up to 28 days of age if they require (or are expected to require) IV calcium treatment, or calcium-containing infusions because of the risk of precipitation of ceftriaxone-calcium (refer to SPC).
• In patients of any age must not be mixed or administered simultaneously with any calcium-containing IV solutions, even via different infusion lines or at different infusion sites.
• In patients > 28 days, calcium-containing solutions may be administered sequentially if infusion lines at different sites are used or if the infusion lines are replaced or thoroughly flushed between infusions with physiological salt-solution to avoid precipitation.
• In patients requiring continuous infusion with calcium-containing TPN solutions, healthcare professionals may wish to consider the use of alternative antibacterial treatments which do not carry a similar risk of precipitation.

Add vancomycin if there is concern regarding possibility of beta-lactam resistant pneumococci,
(e.g. Gram positive cocci (possibly pneumococci) seen on CSF Gram stain) and use until susceptibility of isolate is confirmed. Consultation with microbiologist is recommended</td><td>Rapid sterilisation of blood and/or CSF using antibiotic of adequate activity and potency in an appropriate dose</td></tr>
<tr><td>4. DRAW BLOODS STAT</td><td>Listed in order of priority:
Venous blood gas, FBC, Diff., Bacterial PCR as appropriate (meningococcal, pneumococcal, haemophilus, GpB Strep), PT, APTT, Fibrinogen, d-dimers, Protein C, Diastix, Blood culture, glucose, U & E, Ca, $P0_4$, Mg, LFTs, Lactate, Group and hold</td><td>Rapid diagnostic evaluation</td></tr>
</table>

5. GIVE DEXAMETHASONE BEFORE OR AT THE TIME OF ANTIBIOTICS	Ideally steroids should be given either before or at the time of antibiotic administration. They are unlikely to be of benefit if given more than 24 hours after antibiotic therapy has been commenced Dexamethasone phosphate 0.15mg/kg/dose every 6 hrs for 4 days <u>Research evidence:</u> • Proven benefit in children with Hib meningitis [16,26] • Improved outcome for adults with bacterial meningitis[27,29] • Inconsistent evidence from animal models of pneumococcal meningitis although benefit in children reported[30] • Not uniformly advocated[31] • Two regimens have been used with similar outcomes	Improve outcome Minimise neurologic sequelae and prevent deafness
6. GIVE IV/IO ANTIBIOTICS WITHOUT UNDUE DELAY	**Antibiotics may be deferred until after LP where such is planned without delay** **If delay prior to LP is anticipated (such as time to obtain CT scan if deemed necessary) then antibiotics should not be withheld but should be given even if the LP has not yet been performed** **Ceftriaxone special precautions:** see No.3 above For infants ≤ 8 weeks (2 months) the addition of amoxicillin is to provide cover for listeria and enterococci and the addition of gentamicin to enhance GNB cover and synergistic increase in activity against group B streptococci	
7. COMMENCE IV FLUIDS If **haemodynamically unstable** refer to Sepsis Guideline Action section C, point 5	Crystalloid fluids (e.g. Hartmann's or 0.9% w/v NaCl) should start at 100% of maintenance requirements Assess need for bolus fluid :- e.g. 20 mls/kg isotonic crystalloid (e.g. Hartmann's or 0.9% w/v NaCl) or colloid stat, if clinical evidence of dehydration	Cautious rehydration Treat shock if present
8. EVALUATE FOR PRESENCE OF CEREBRAL OEDEMA **ASSUME PATIENT HAS CEREBRAL OEDEMA IF**:- • Serum Na is < 135mmol/L and signs of raised ICP are present **<u>or</u>** • Serum Na is < 130mmol/L even in the absence of clinical signs of raised ICP MANAGEMENT OF PATIENTS WITH CEREBRAL OEDEMA REQUIRES CONSULTANT CONSULTATION	**Signs of raised ICP include** • Decreased or fluctuating level of consciousness • Hypertension and relative bradycardia • Unequal, dilated or poorly responsive pupils • Focal neurological signs • Seizures, abnormal postures • Papilloedema Patients suspected of having cerebral oedema should be treated with 0.9% w/v NaCl or 5% w/v albumin Mannitol (0.25g/kg) or 3% saline (2-3 mls/kg) over 20 minutes bolus may be required. (Discuss with nephrology consultant if renal dysfunction present) Urinary catheter to monitor output Early brain CT to potentially confirm/out rule cerebral oedema **DO NOT ATTEMPT LP IF SIGN(S) OF RAISED ICP**	Early recognition of raised ICP Avoid brain herniation Avoid hypercapnia or hypoxia

9. IF CEREBRAL OEDEMA/RAISED ICP, PATIENT REQUIRES INTENSIVE CARE with GUIDED NEUROLOGICAL CARE	30-degree° head-of-bed elevation, midline position Avoid internal jugular vascular access Repeat mannitol and furosemide if indicated Sedate Cautious fluid resuscitation but shock must be corrected Minimal handling, monitor pupillary size and reaction Cooling -The role of cooling in adults is very uncertain- it reduces ICP but no clear evidence of benefit on outcome	
10. CONSIDER INTUBATION	Intubation may be required if there is: • an altered level of consciousness • ↑ ICP • if pulmonary oedema is anticipated -if >40-60 mls/kg of resuscitation fluid Early intubation can be advantageous in children. In the unstable child, intubation is a *prerequisite* for inter-hospital transfer. If considering insertion of a central line, intubate first (regardless of level of consciousness). If indicated, intubation should take place *before* moving the patient e.g. from ED to ICU.	Secure airway Ventilate to control $PaCO_2$ (4 – 4.5 kPa)- normocapnoea Lessen hypoxaemia Reduce oxygen consumption Maintain inspiratory plateau <30cm for adults and <25cm for children Keep CVP 12 -15 mmHg if central line in situ – ScvO2>70%
11. LUMBAR PUNCTURE SHOULD BE CARRIED OUT IF THE PATIENT IS HAEMODYNAMICALLY STABLE AND THERE ARE NO CONTRAINDICATIONS Contraindications to LP: • Signs of raised intracranial pressure • Haemodynamic or respiratory instability • Sepsis in area though which needle will pass • Evidence of coagulopathy, or platelet count < 100 in absence of coagulopathy	**4 samples of CSF** (8 - 10 drops per tube) for 1. cell count 2. protein and glucose 3. microscopy and c/s (incl. viral c/s) 4. bacterial PCR testing (meningococcal haemophilus, pneumococcal, GpB Strep) In selected situations CSF may also be sent for PCR testing to detect HSV1, HSV2, CMV, EBV, & VZV and enteroviruses (National Virus Reference Laboratory). Consider reserving an additional sample to be sent if needed. **Patients in whom CT recommended prior to LP include:** • Immunocompromised state (HIV/AIDS, post- transplant) • History of CNS disease • New onset seizure • Papilloedema • Abnormal level of consciousness • Focal neurologic signs **Indications for repeat LP:** • Failure of response after 48 hrs of appropriate antimicrobial therapy • Neonates with gram-negative bacillary or group B streptococcal meningitis (to document sterilisation, because duration of therapy is determined, in part, by the result)	Confirm diagnosis of meningitis and establish a microbiologic diagnosis The only way to definitively ascertain the presence or absence of meningitis is to examine the CSF. As this will impact on the necessary follow-up of patients, it should be strongly considered in all cases if meningitis is suspected.

12. REASSESS CLINICALLY	Monitor blood glucose and assess need for dextrose Hypoglycaemia should be treated with 5ml/kg of 10% dextrose solution and subsequent inclusion of dextrose in maintenance fluids Assess K+ needs as soon as U&E results available	Maintain glucose ≥ lower limit of normal, but < 10 mmol/L. Maintain K+ within normal range
13. IF MENINGOCOCCAL INFECTION SUSPECTED OBTAIN THROAT SWAB and/or PERNASAL SWAB	For epidemiological purposes **Important as may be only site to yield isolate, especially, if antibiotics have been given.** Throat swab - a full sweep of the pharyngeal wall and tonsils, from all patients. If not possible, obtain a pernasal swab rotated on the posterior pharyngeal wall	Monitor epidemiology of bacterial sepsis and meningitis. Of critical importance in era of introduction of 'meningitis vaccines'
14. CONSIDER FURTHER CONSULTATION	Microbiology, neurology, nephrology, infectious diseases input may be helpful. Early orthopaedic input if required (for fasciotomy), plastic surgery if required	
15. NOTIFY PUBLIC HEALTH AND INFECTION CONTROL as soon as possible **Ensure Contact Chemoprophylaxis** if necessary (See Chapter 7, 8, 9, Appendix 4) **and information as per agreed protocol.**	Under the statutory Infectious Diseases Regulations 1981, amended 2003, cases or suspect cases of bacterial meningitis or meningococcal septicaemia must be notified immediately to the Department of Public Health (Medical Officer of Health). **Telephone notification should be used initially, as a matter of urgency. This is the responsibility of the admitting team.** All telephone notifications must be followed by written notification.	

SECTION C:

Guidelines for the MANAGEMENT OF Community Acquired Bacterial sepsis/ meningitis, including Meningococcal Infection for the Haemodynamically UNSTABLE patient

Summary of management approach
1. ABC management ➢ Assess and maintain **airway and breathing** as required ➢ Administer 100% O_2 at 15 L/Min ➢ Assess **circulation** and secure vascular access (Intravenous or Intraosseous)
2. Summon help, alert ICU Team
3. Order first dose antibiotics to be drawn up
4. Draw bloods stat
5. Initiate fluid resuscitation
6. Give IV/IO antibiotics without delay
7. Reassess clinically
8. Lumbar puncture should NOT be carried out at this time
9. Consider intubation
10. Continue resuscitation
11. For patients who are unresponsive to fluid and inotrope resuscitation - give low dose steroids
12. Manage coagulopathy if present
13. If meningococcal infection suspected obtain throat swab and/or pernasal swab
14. Consider further consultation (microbiology/haematology/nephrology/infectious diseases)
15. Consider renal replacement therapy
16. Notify public health & infection control. Initiate contact chemoprophylaxis and information as per agreed protocol if necessary

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• In patients of any age must not be mixed or administered simultaneously with any calcium-containing IV solutions, even via different infusion lines or at different infusion sites.
• In patients > 28 days, calcium-containing solutions may be administered sequentially if infusion lines at different sites are used or if the infusion lines are replaced or thoroughly flushed between infusions with physiological salt-solution to avoid precipitation.
• In patients requiring continuous infusion with calcium-containing TPN solutions, healthcare professionals may wish to consider the use of alternative antibacterial treatments which do not carry a similar risk of precipitation.

Add vancomycin if there is concern re possibility of beta-lactam resistant pneumococci, e.g. if Gram positive cocci (possibly pneumococci) seen on CSF gram stain and use until susceptibility of isolate confirmed. Consultation with microbiologist is recommended</td><td>Rapid sterilisation of blood and/or CSF using antibiotic of adequate activity and potency in an appropriate dose</td></tr>
<tr><td>4. DRAW BLOODS STAT</td><td>Listed in order of priority:
Venous blood gas, FBC, diff, Bacterial PCR as appropriate (meningococcal, pneumococcal, haemophilus, GpB Strep), PT, APTT, fibrinogen, d-dimers, protein C, Diastix, Blood culture, glucose, U & E, Ca, $P0_4$, Mg, LFTs, Lactate, Group & hold</td><td>Rapid diagnostic evaluation</td></tr>
</table>

5. INITIATE FLUID RESUSCITATION	Minimum of 20 mls/kg isotonic crystalloid (e.g. Hartmann's or 0.9% w/v NaCl) or colloid stat. Crystalloid fluid administration should be at 100% of maintenance requirements until cardiovascular stability is restored. Start immediately with Hartmann's, normal saline, or colloid. Hartmann's is physiologically the best solution but colloid fluid therapy (5% w/v albumin) may be used in the early resuscitation period. **Critical to evaluate after initial resuscitation and determine if goals met. If not succeeding consider early intubation and commencing inotropes** **Continuous re-evaluation of response to interventions, with repeated intervention as necessary essential until goals achieved**	CVP 8 – 12 mmHg Age appropriate MAP: • Infant/young child ~ 45mmHg • Older child ~ 55mmHg • Adolescent/adult ≥ 65mmHg Urine output > 1ml/kg/hr Central venous oxygen (ScvO2) of ≥ 70% or Mixed venous O_2 saturation (Sv O2) of ≥ 65% Lactate < 2 mmols/L or falling Maintain Hb 7 - 9 g/dl (desired level dependent on co-morbidities)
6. GIVE IV/IO ANTIBIOTICS WITHOUT DELAY	Ceftriaxone special precautions: see No.3 above For infants < 8 weeks (2 months) the addition of amoxicillin is to provide cover for listeria and enterococci and of gentamicin to enhance GNB cover and synergistic increase in activity vs. group B streptococci.	
7. REASSESS CLINICALLY	Reassess fluid requirements frequently **If meningitis/ ICP, re-assess fluid needs** If continued evidence of haemodynamic instability, repeat fluid bolus in accordance with response to resuscitation Monitor blood glucose and assess need for dextrose Hypoglycaemia should be treated with 5ml/kg of 10% dextrose solution and subsequent inclusion of dextrose in maintenance fluids Assess K+ needs as soon as U&E results available	Maintain glucose ≥ lower limit of normal, but < 10 mmol/L. Maintain K+ within normal range
8. LUMBAR PUNCTURE SHOULD NOT BE CARRIED OUT AT THIS TIME		The only definitive way to ascertain the presence or absence of meningitis is to examine CSF. As this will impact on necessary patient follow-up, LP should be considered when the patient stabilises and provided there are no contra-indications to LP. This may be on Day 2 or 3.

9. CONSIDER INTUBATION	Intubation may be required if there is an altered level of consciousness • ↑ICP • if pulmonary oedema anticipated or > 40-60 mls/kg resuscitation fluid If indicated, intubation should take place *before* moving the patient e.g. from ED to ICU. Doses of anaesthetic induction agents will need to be modified in shocked cases. **Ketamine is the drug of choice for shocked paediatric patients** (in patients with normal CSF flow, ketamine increased cerebral perfusion pressure (CPP) (advantage). Drugs that lower mean arterial pressure (MAP) will decrease CPP (disadvantage). It should be used with special caution in patients with preanaesthetic elevated cerebrospinal fluid pressure.	**For mechanically ventilated patients:** • Maintain inspiratory plateau <30cm for adults and <25cm for children. • Keep CVP 12 – 15mmHg (if central line in-situ) [32] • Secure airway • Lessen hypoxemia • Reduce oxygen consumption • Stabilise the patient
10. CONTINUE RESUSCITATION If fluid bolus ≥ 40 ml/kg required • Consider intubation and **ventilation** (see above) If fluid bolus ≥ 60 ml/kg • **Insert central line** • **Insert arterial line** • **Commence inotropes** • **Catheterise** • **Monitor urine output**	Inotropic agents may be required where blood pressure is not responding to fluid resuscitation. The most suitable inotrope is best determined on clinical assessment of cardiac output state by a doctor familiar with such assessment and use of such agents within a critical care unit.	It is vitally important to recognise compensated shock as children have great capacity to increase heart rate and vasoconstrict to maintain BP. • **Adrenaline:** 300micrograms/kg in 50 ml NaCl 0.9% w/v 1ml/hr =0.1microgram/kg/min • **Noradrenaline:** 300micrograms/kg in 50 ml NaCl 0.9% w/v 1ml/hr =0.1microgram/kg/min • **Dobutamine (dilute strength):** 3 mg/kg in 50 ml 5% w/v dextrose and run at 5 – 20 ml/hr = 5 – 20 micrograms/kg/min
11. FOR PATIENTS WHO ARE UNRESPONSIVE TO FLUID AND INOTROPE RESUSCITATION - GIVE LOW DOSE STEROIDS	Hydrocortisone • **Adult dose:** 50mg IV 6 hourly (200mg/day in 4 divided doses) • **Paediatric dose:** 1–2 mg/kg/dose IV every 6 hours (*Note:* hydrocortisone recommended for paediatric patients with refractory shock resistant to inotropes)	

12. MANAGE COAGULOPATHY IF PRESENT **HAEMATOLOGY CONSULTATION REQUIRED**	Review coagulation screening results: • If PT and/or APPT > 2ULN (upper limit of normal) – give Octoplas®, 10 – 20 ml/kg • If Fibrinogen < 1.5g/L correct with fibrinogen concentrate (Riastap/ Haemocomplettan). It should be given at a dose of 70 mg/kg and the fibrinogen level rechecked 1 hour following completion of the infusion • Reserve platelet transfusion for those with active bleeding or if platelet count < 20 x 10^9/L and severe consumptive coagulopathy. If indicated transfuse with 20 mls/kg of platelets for children and 1 bag (pool) for adults The order in which blood products and anticoagulants are optimally used can vary from patient to patient and may significantly affect outcome. **It is critical that guidance from a haematologist experienced in the management of meningococcal coagulopathy be obtained** OCTOPLAS® is the plasma replacement used to correct consumptive coagulopathy in bleeding patients, as it contains a wide selection of coagulant and anticoagulant factors.	**Aggressive correction of coagulation defects is essential to optimise outcome** **Maintain:** • Hb 7.0 – 9.0g/L (according to co-morbidity) • PT and APPT <2 ULN (upper limit of normal) • Fibrinogen >1.5g/L • Platelets > 20 x 10^9/L • ACT of 150 – 200
13. IF MENINGOCOCCAL INFECTION SUSPECTED OBTAIN THROAT SWAB and/or PERNASAL SWAB	For epidemiological purposes- **Important as may be only site to yield isolate, especially, if antibiotics have been given** Throat swab – a full sweep of the pharyngeal wall and tonsils, from all patients. If not possible, obtain a pernasal swab rotated on the posterior pharyngeal wall.	Monitor epidemiology of bacterial sepsis and meningitis. Of critical importance in era of introduction of 'meningitis vaccines'
14. CONSIDER FURTHER CONSULTATION	Microbiology, haematology, nephrology, infectious diseases and infection control input may be helpful	
15. CONSIDER RENAL REPLACEMENT THERAPY	Continuous renal replacement therapy (CRRT) - Veno-venous haemofiltration, haemodiafiltration and plasmapharesis are all used in the management of severe sepsis	Early rather than delayed CRRT may be beneficial
16. NOTIFY PUBLIC HEALTH and INFECTION CONTROL as soon as possible **Ensure contact chemoprophylaxis and information as per agreed protocol if necessary (See Chapter 7,8,9,Appendix 4)**	Under the statutory Infectious Diseases Regulations 1981, amended 2003, cases or suspect cases of bacterial meningitis or meningococcal septicaemia must be notified immediately to the relevant department of public health (medical officer of health). Telephone notification should be used initially and this is the responsibility of the admitting team. This should be done as a matter of urgency. All telephone notifications must be followed by written notification.	

Reference normal vital signs - values

The abnormal vital signs by age groups are demonstrated in Table 3.1

Table 3.1. Age specific abnormal vital signs – cut-offs

Age group	Heart rate, beats/minute		Tachypnoea (breaths/min)	Hypotension (mm Hg)
	Tachycardia	Bradycardia		
0 days - 1 wk	>180	<100	>50	<65
1 wk - 1 mo	>180	<100	>40	<75
1 mo - 1 yr	>180	<90	>34	<100
2 - 5 yrs	>140	NA	>22	<94
6 - 12 yrs	>130	NA	>18	<105
13 - 18 yrs	>110	NA	>14	<117

Lower rates for heart rate and systolic blood pressure are for the 5th percentile and upper values for heart rate or respiration for the 95th percentile
NA = not applicable

Antibiotic doses and duration of treatment commonly used in empiric therapy

N.B. doses listed are given intravenously (iv)

Empiric treatment is based on likely organisms. As soon as microbiologic diagnosis is obtained by culture or PCR result choice of antibiotics should be reviewed and appropriate changes made. Empiric treatment is age related.

Usual adult doses (max dose for a large child)
Ceftriaxone 2g every 12 hours or 4g every day
Cefotaxime 2g every 4 to 6 hours (max 12g daily)
Benzylpenicillin 2.4g every 4 hours
Amoxicillin 2g every 4 hours
Meropenem 2g every 8 hours (used in penicillin allergy)

The following tables detail dosage and frequency indicated for patients based on age and weight of patients.

Table 3.2. Antibiotics - Age related doses (mg/kg/dose) and frequency

Age	Drug	mg/kg/dose	Frequency according to age
0 - 1 mos (neonate, 0-4 wks)[1]	Amoxicillin	100mg/kg	<7 days: every 12 hrs 7 – 28 days: every 8 hrs (Modify if premature)
	Gentamicin	2.5mg/kg	every 12 hrs (Aim for peak = 6 – 10mg/L, trough < 2mg/L) (Modify if premature)
	Cefotaxime[2]	50mg/kg	<7 days: every 12 hrs 7 – 28 days: every 8 hrs >28 days: every 6 hrs
1 - 2 mos (4-8 wks)	Amoxicillin	50mg/kg	every 4 hrs
	Cefotaxime[2]	50mg/kg	every 6 hrs
	Ceftriaxone	80mg/kg	every 12 hrs for first 3 doses, and then once daily
	Gentamicin	2.5mg/kg	every 8 hrs (Aim for peak = 6 – 10mg/L, trough <2mg/L)
>2 mos	Cefotaxime[2]	50mg/kg (Max 12g daily)	every 6 hrs
	Ceftriaxone	80mg/kg (Max 4g daily)	every 12 hrs for first 3 doses, and then once daily
	Vancomycin [4]	15mg/kg/dose **(Max 2g/daily)**	every 6 hrs (Aim for trough 15 – 20 mg/L) (Modify dose if premature)
Adults	Cefotaxime[2]	50mg/kg (Max 12g daily)	every 6 hrs
	Ceftriaxone	80mg/kg (Max 4g/daily)	every 12 hrs for first 3 doses, and then once daily
	Vancomycin [4]	15mg/kg **(Max 2g/daily)**	every 6 hrs (Aim for trough 15 – 20 mg/L)
	Amoxicillin	2g	every 4 hrs

For explanatory footers see below table 3.3

Table 3.3. Additional antibiotic doses that may be indicated (mg/kg/dose)

Antibiotic	Route	Dose according to age	Frequency according to age
Benzyl Penicillin[3]	IV	75mg/kg Adult: 2.4g every 4 hrs	<7 days: every 12 hrs >7 days – 28 days: every 8 hrs >28 days: every 4 hrs
Meropenem [3]	IV	40 mg/kg Adult: 2g every 8 hrs	<7 days every 12 hrs >7 days: every 8 hrs
Rifampicin[5]	PO	< 28 days: 5 mg/kg > 28 days - 12 years: 10 mg/kg Adult: 600 mg every 12 hrs	every 12 hrs

For explanatory footers see below:

1. **In neonatal meningitis,** when the susceptibility of the organism is known *and* the CSF is sterilised, modify antibiotics to the most active and least toxic. For group B streptococcus this is benzylpenicillin, for listeria this is amoxicillin. With Gram negative organisms, choice will depend on susceptibility data. Frequency of dosing may need to be modified for premature infants.

2. **Ceftriaxone**
- Is contraindicated in newborns up to 28 days of age if they require (or are expected to require) IV calcium treatment, or calcium-containing infusions because of the risk of precipitation of ceftriaxone-calcium.
- In patients of any age must not be mixed or administered simultaneously with any calcium-containing IV solutions, even via different infusion lines or at different infusion sites.
- In patients > 28 days, calcium-containing solutions may be administered sequentially if infusion lines at different sites are used or if the infusion lines are replaced or thoroughly flushed between infusions with physiological salt-solution to avoid precipitation.
- In patients requiring continuous infusion with calcium-containing TPN solutions, healthcare professionals may wish to consider the use of alternative antibacterial treatments which do not carry a similar risk of precipitation.

3. **A clear history of penicillin anaphylaxis** is a contraindication to use of penicillin or cephalosporins. A history of non-urticarial skin rash or gastrointestinal upset is **not** a contraindication to penicillin therapy. Meropenem is indicated if there is a history of penicillin anaphylaxis.
4. **If initial CSF Gram stain show Gram positive cocci, consistent with pneumococcal meningitis, add vancomycin** pending confirmation of sensitivity of isolate to penicillin and cephalosporins
5. If dexamethasone has been given and resistant pneumococcal meningitis likely, add rifampicin, as dexamethasone can reduce CSF penetration of vancomycin.

The recommended duration of treatment for specific infections is specified in Table 3.4.

Table 3.4. Minimum duration of IV antibiotic therapy (total course must be given IV*)

Bacterial meningitis (organism specific)	Duration IV antibiotic therapy (days)
Uncomplicated meningococcal infection	7 days
Uncomplicated *Haemophilus* infection	10 days
Uncomplicated pneumococcal infection	14 days
Group B streptococcal infection	14-21 days
Listeria infection	21 days
Aerobic Gram negative infection	21 days (min 21 days or 14 days post sterilisation of CSF, whichever is longer)

**IV; Intravenously*

CHAPTER 4: SURVEILLANCE

Key points

Surveillance is required to:
- Ensure prompt identification and appropriate management of cases and close contacts in order to implement appropriate control and communication measures to monitor changes in epidemiology and effectiveness of control measures to provide evidence for local and national guidelines

Case definitions used in surveillance are available (see section 4.3 below and on HPSC website)

Clinicians and laboratories are legally required to:
- Notify all cases of suspected bacterial meningitis, invasive meningococcal or Hib disease to public health immediately without waiting for microbiological confirmation
- Notify all cases of pneumococcal meningitis upon microbiological confirmation

Departments of public health should:
- Undertake enhanced surveillance on all cases
- Implement prompt public health interventions as appropriate
- Monitor disease incidence and trends
- Evaluate public health interventions and policies
- Review regularly surveillance data at local level (Health Protection Surveillance Centre reviews data at both national and regional level).

4.1 Surveillance of bacterial meningitis (including meningococcal, Hib, pneumococcal, streptococcal group B disease)

Surveillance is based on notification of cases by clinicians and laboratories. Notification is a statutory requirement of both clinicians and laboratories.

4.2 Objectives of surveillance

The objectives of disease surveillance are:
- To ensure prompt identification and appropriate management of cases
- To ensure prompt identification of close contacts in order to implement appropriate control and communication measures
- Public health control measures are required for meningococcal disease and *H. influenzae* type b disease (and rarely invasive pneumococcal disease) to prevent ongoing transmission
- To monitor changes in the epidemiology of the disease in relation to serogroup, serotype and antibiotic susceptibility
- To monitor effectiveness of current control measures (vaccination programmes, chemoprophylaxis to contacts)
- To provide an evidence base for local and national guidelines.

All clinicians and laboratories should immediately notify cases of suspected meningococcal or *H. influenzae* infection by telephone, fax, or email. Laboratories using CIDR should also report all cases through CIDR. Notification of suspect meningococcal or Hib cases should not be delayed until microbiological confirmation is obtained.

4.3 Surveillance case definitions [33]

Case definitions have been defined for all notifiable disease in Ireland since 2003 and updated cases definitions were produced in January 2012. A case definition means the set of clinical or microbiological characteristics by which a case of infectious disease is defined. This information is used to classify the notifications as possible, probable or confirmed. The classification according to the different levels might vary according to the epidemiology of the individual diseases.

Prior to this case definitions for meningococcal disease had already been defined and were used for surveillance.

The following case definitions are used to define the most commonly reported notifiable diseases associated with meningitis.

4.3.1. Bacterial meningitis (not otherwise specified) (case definition 2012)

Clinical criteria
Any person with the following clinical picture: bacterial meningitis manifests most commonly with fever, headache, and a stiff neck; the disease may progress rapidly to shock and death. However, other manifestations may be observed.

Laboratory criteria for a confirmed case
At least one of the following two:
- Isolation of a bacterial species from the cerebrospinal fluid (CSF)
- Detection of a bacterial species nucleic acid from CSF

Laboratory criteria for a probable case
At least one of the following two:
- Detection of bacteria in CSF by microscopy e.g. Gram stain
- CSF white cell count (WCC) differential, protein and glucose levels consistent with bacterial meningitis

Epidemiological criteria
NA

Case classification
A. Possible case
- Any person meeting the clinical criteria

B. Probable case
- Any person meeting the clinical criteria and the laboratory criteria for a probable case

C. Confirmed case
- Any person meeting the laboratory criteria for a confirmed case

Note:
1. Exceptions: Nosocomial bacterial meningitis *directly related to invasive procedures* (e.g. craniotomy, placement of internal or external ventricular catheters, lumbar puncture, intrathecal infusions of medications, or spinal anesthesia), complicated head trauma, or in rare cases, metastatic infection in patients with hospital-acquired bacteremia is not notifiable. These cases of meningitis are caused by a different spectrum of microorganisms than cases acquired in the community setting and illness is the result of diverse pathogenic mechanisms.

2. Notification of specified diseases causing meningitis: If a diagnosis of meningitis due to *Haemophilus influenzae*, *Neisseria meningitidis*, *Streptococcus pneumoniae, Streptococcus* Group B infection (invasive) or another listed bacterial pathogen has been made (even if they are considered to be a nosocomial case), please see the case definition for the particular disease/pathogen and notify under the relevant disease.

4.3.2. Meningococcal case definition (amended case definition 2012)
Neisseria meningitidis

Clinical criteria
Any person with symptoms compatible with meningococcal disease including:
- Meningeal signs
- Haemorrhagic rash
- Septic shock
- Other manifestations are possible

Laboratory criteria for a confirmed case
At least one of the following three:
- Isolation of *Neisseria meningitidis* from a normally sterile site or from haemorrhagic skin lesions
- Detection of *Neisseria meningitidis* nucleic acid from a normally sterile site or from haemorrhagic skin lesions *(note: see laboratory section for further information)*
- Detection of *Neisseria meningitidis* antigen in CSF

Laboratory criteria for a probable case
At least one of the following two:
- Detection of gram-negative stained intracellular diplococci in CSF or from haemorrhagic skin lesions
- Isolation of *Neisseria meningitidis* from a nonsterile site (together with compatible purpuric rash or CSF findings compatible with bacterial meningitis)

Laboratory criteria for a possible case

- Isolation of *Neisseria meningitidis* from a non-sterile site (e.g. eye, throat or nasal swab)

Note: Serogrouping of the isolates should be performed.

Epidemiological criteria

An epidemiological link by human to human transmission

Case classification

A. **Possible case**

- Any person meeting the clinical criteria with characteristic rash **OR**
- Any person meeting clinical criteria and the laboratory criteria for possible case **OR**
- Any person meeting clinical criteria who received pre-admission antibiotics but is culture negative

B. **Probable case**

- Any person meeting the clinical criteria and with an epidemiological link to a confirmed case
  OR
- Any person meeting the clinical criteria and the laboratory criteria for a probable case

C. **Confirmed case**

- Any person meeting the laboratory criteria for a confirmed case

4.3.3. *H. influenzae* disease (invasive) (case definition - 2012)

Clinical criteria

Any person with clinical picture compatible with invasive disease, i.e. bacteraemia, meningitis, arthritis, epiglottitis, osteomyelitis or cellulitis

Laboratory criteria

At least one of the following two:

- Isolation of *Haemophilus influenzae* from a normally sterile site
- Detection of *Haemophilus influenzae* nucleic acid from a normally sterile site

Note: Typing of the isolates should be performed

Epidemiological criteria

NA

Case classification

A. **Possible case**

- A case with clinical epiglottis without any laboratory confirmation or with identification only from a non-sterile site

B. **Probable case**

- NA

C. **Confirmed case**

- Any person meeting the laboratory criteria

4.3.4. Streptococcus group B infection (invasive) (case definition - 2012)
Streptococcus agalactiae (blood, CSF or other normally sterile site)

Clinical description

Only group B streptococci (invasive) in infants <90 days old or stillborn infants is notifiable.
In neonates two syndromes exist:

- Early-onset (<7 days old)
- Late-onset (7-89 days old)

Both include sepsis, pneumonia and meningitis.
Stillbirth associated with isolation/detection of *Streptococcus agalactiae* from the placenta or amniotic fluid is notifiable.

Laboratory criteria

At least one of the following four:

- Isolation of *S. agalactiae* from a normally sterile site
- Detection *S. agalactiae* nucleic acid from a normally sterile site
- Isolation of *S. agalactiae* from the placenta and/or amniotic fluid, with foetal demise
- Detection of *S. agalactiae* nucleic acid from the placenta and/or amniotic fluid, with foetal demise

Epidemiological criteria
NA

Case classification
A. **Possible case**
- NA

B. **Probable case**
- NA

C. **Confirmed case**
- Any infant or stillborn infant meeting the laboratory criteria

4.3.5. Streptococcus pneumoniae infection (invasive) (amended case definition - 2012) (further amendments July 2015)

Clinical criteria
Not relevant for surveillance purposes

Laboratory criteria for a confirmed case
At least one of the following three:
- Isolation of *S. pneumoniae* from a normally sterile site
- Detection of *S. pneumoniae* nucleic acid from a normally sterile site[1]*
- Detection of *S. pneumoniae* antigen from a normally sterile site*

Epidemiological criteria
NA

Case classification
A. **Possible case**
- NA

B. **Probable case**
- NA

C. **Confirmed case**
- Any person meeting the laboratory criteria

4.4. Infectious Disease Notification legislation and process

Under the 1981 Infectious Disease Regulations[34] which were revised in 1985, 1988 and 1996 medical practitioners who become aware of, or who suspect, a person is suffering from, or is a carrier of, an infectious disease specified in the regulations are required to notify the relevant medical officer in the appropriate health board.

From 2000, the medical officers in the Health Service Executive areas (formerly known as health boards) furnished weekly notification data to HPSC (formerly known as NDSC) under the Infectious Disease (Amendment) Regulations 2000.[7]

Since 2004, a new national computerised infectious disease reporting system (CIDR) has been implemented on a phased basis across the country. By December 2010 all eight HSE areas were using CIDR (covering 100% of the population). Case-based data are inputted into CIDR as soon as they are available.

1 *note: In children under 2 years of age pneumococcal carriage may result in blood antigen or PCR positivity and results should be interpreted with caution in the light of clinical observations.
† note: In children under 2 years of age carriage may result in urine antigen positivity and results should be interpreted with caution in the light of clinical observations.

4.5 Surveillance data

The surveillance data currently collected includes epidemiological, laboratory and clinical information. Disease specific enhanced data are also collected (detailed below).

Identification of clusters in time and place with the same risk factors or serogroups, serotypes and serosubtypes for meningococcal disease is a particular cause for concern, as such clusters, if caused by the same strain may require the implementation of specific control measures. Clusters of meningitis illness even when of unknown aetiology should be reported immediately to the local department of public health.

The requirements for data are different at local/regional and national levels. Information locally includes named patient data and data relevant to contact tracing activities (names of contacts, contact details and information relating to preventive measures taken). Named patient data are not routinely provided nationally.

The following data items are collected by departments of public health on all suspect cases of bacterial meningitis (meningococcal, *H. influenzae* and pneumococcal) and are core data for surveillance:

- Patient demographic details and HSE area
- Information relating to disease: dates of onset and notification
- Disease, organism.

Enhanced surveillance of bacterial meningitis (including meningococcal septicaemia) commenced in Ireland in 1997, for invasive disease caused by *N. meningitidis and H. influenzae* since 1999 and for invasive pneumococcal disease in children since 2008.
Under the enhanced surveillance system additional data items are collected and include data relating to hospital admission, clinical presentation and disease outcome, laboratory investigations and results, final diagnosis, further detail on organism and strain details, disease specific vaccination history, and risk factors for infection. Data are entered onto CIDR by both laboratories and departments of public health. See enhanced forms in Appendix 3 for details on data collected.

4.6. Analysis and reporting of surveillance data

The data provided through the national surveillance system allows complete epidemiological analysis on all notifications of bacterial meningitis. This system has been used to identify trends and the impact of vaccine programmes and control measures. Continuous monitoring is required (see Chapter 5 on epidemiology for details on analysis).

Quarterly and annual reports are prepared by the HPSC and are available on the HPSC website (www.hpsc.ie) for bacterial meningitis and invasive meningococcal disease, *H. influenzae* invasive disease and invasive pneumococcal disease.

CHAPTER 5.
EPIDEMIOLOGY OF MENINGOCOCCAL DISEASE AND OTHER FORMS OF BACTERIAL MENINGITIS (IRELAND)

Key points

- **The incidence of bacterial meningitis including invasive meningococcal disease peaked in 1999, at 16.2 cases per 100,000 and has fallen to 4.3 cases per 100,000 in 2010**
- **Meningococcal disease continues to account for the majority of bacterial meningitis notifications**
- **Serogroup B is the most common infecting *Neisseria meningitidis* serogroup in Ireland**
- **MenC and Hib vaccines have had a major impact in reducing the morbidity and mortality from invasive Men C and Hib disease respectively**
- ***Streptococcus pneumoniae* is the second most common organism causing bacterial meningitis notified in Ireland**
- **There has been a decline in pneumococcal disease following the recent (2008) introduction of pneumococcal conjugate vaccine (PCV) to the childhood immunisation programme**

5.1. Introduction

The epidemiology of bacterial meningitis caused by *N. meningitidis, H. influenzae,* and *S. pneumoniae* has changed following the introduction of vaccines to prevent meningococcal C disease, *H. influenzae* type b disease, and the most common pneumococcal serotypes. The impact of these vaccines is evident in the following sections relating to each disease.

5.2. Vaccines routinely used in Ireland

Vaccines used to prevent the most common causes of meningitis (date of introduction and current schedule (2010) include the following vaccines detailed below).

Meningococcal C (MenC) vaccine

This vaccine was introduced in October 2000. The vaccine was administered for all infants in the first year of life (three doses) and a once off catch-up for all < 23 years of age (one dose).

In September 2008, there was a change in the schedule of MenC vaccine; two doses were recommended in the 1st year of life and 1 dose (booster) in the 2nd year of life.

Hib vaccine

This vaccine was introduced in 1992. The vaccine was recommended for all infants in the first year of life (three doses).

In 2005, a once off Hib booster catch-up campaign for all children < 4 years of age was implemented. In September 2006 a routine Hib booster was introduced into the programme. The recommended schedule is three doses Hib vaccine for all infants in the 1st year of life and one dose (booster) in the 2nd year of life

Conjugate Pneumococcal vaccine PCV7

This vaccine was introduced into the childhood immunisation programme in September 2008. The recommended schedule is two vaccine doses in the 1st year of life and one dose (booster) in the 2nd year of life. A once-off catch-up campaign for children < 2 years of age was implemented at the same time.

In December 2010, the PCV7 vaccine was replaced with the PCV13 (an expanded valency vaccine which offered protection against an additional 6 serotypes). The schedule for administration is unchanged (two doses in 1st year of life and one dose in the 2nd year of life).

More information on the vaccines recommended in Ireland is available from "Immunisation Guidelines for Ireland".[35]

5.3. Background to the surveillance of bacterial meningitis

Bacterial meningitis (including meningococcal septicaemia) was made a notifiable disease at the end of 1981, as specified by the Infectious Disease Regulations, S.I. No. 390 of 1981. On January 1st 2004, the Infectious Diseases (Amendment) (No.3) Regulations 2003 (SI No. 707 of 2003) came into effect. With this amendment there were a number of changes in the specifications with respect to bacterial meningitis notifications.

These changes included:

- Invasive meningococcal disease (IMD) became a notifiable disease in its own right
- Other forms of bacterial meningitis are now notifiable under the specific disease pathogen name as specified in the legislation
- For bacterial meningitis pathogens not listed, these forms of meningitis are notifiable under the disease "bacterial meningitis (not otherwise specified)"
- Laboratories are legally obliged to notify all notifiable infectious diseases
- Case definitions were introduced for the notifiable infectious diseases.

Despite the changes to the legislation, bacterial meningitis data before and after the 2003 amendments are still considered comparable when analysed by causative pathogen since laboratories had always tended to notify cases of bacterial meningitis to public health prior to being legally obliged to do so.

From 1982 until June 2000, medical officers in the HSE areas (former health boards) reported on a weekly basis to the department of health (DoH) the number of each of the infectious diseases notified to them, including bacterial meningitis. In July 2000, responsibility for the collation and analysis of the weekly infectious disease notifications was transferred from DoH to HPSC and the use of an agreed minimum dataset for reporting notifiable infectious diseases nationally came into operation.

In the mid 1990s, there was a dramatic increase in the incidence of bacterial meningitis (including meningococcal septicaemia) (Figure 5.1). In response to this worrying increase the DoH in 1996, provided funding for the establishment of what is now known as the Irish Meningococcal and Meningitis Reference Laboratory (IMMRL) at the Children's University Hospital, Temple Street, Dublin. The aims of the IMMRL were:

- To provide a national service for the non-culture diagnosis of IMD using the DNA-based amplification method, polymerase chain reaction (PCR) on blood and/or CSF specimens.
- To perform epidemiological typing and detailed antibiotic susceptibility testing of all *N. meningitidis* isolates submitted by Irish diagnostic microbiology laboratories.

Enhanced data on all bacterial meningitis cases notified are available nationally since 1999. These data are now on CIDR. Each month HPSC reconciles meningococcal disease notifications on CIDR with the IMMRL database to ensure all laboratory-confirmed cases have been notified. Data on CIDR are also supplemented with additional laboratory information such as sero-subtyping data received from the IMMRL. Throughout the year departments of public health are requested to review their notifications for the year to date to ensure the information recorded is accurate and complete. Following year-end, final data cleaning and validation checks are undertaken by HPSC, in conjunction with the departments of public health and the IMMRL and the data are updated on CIDR as required.

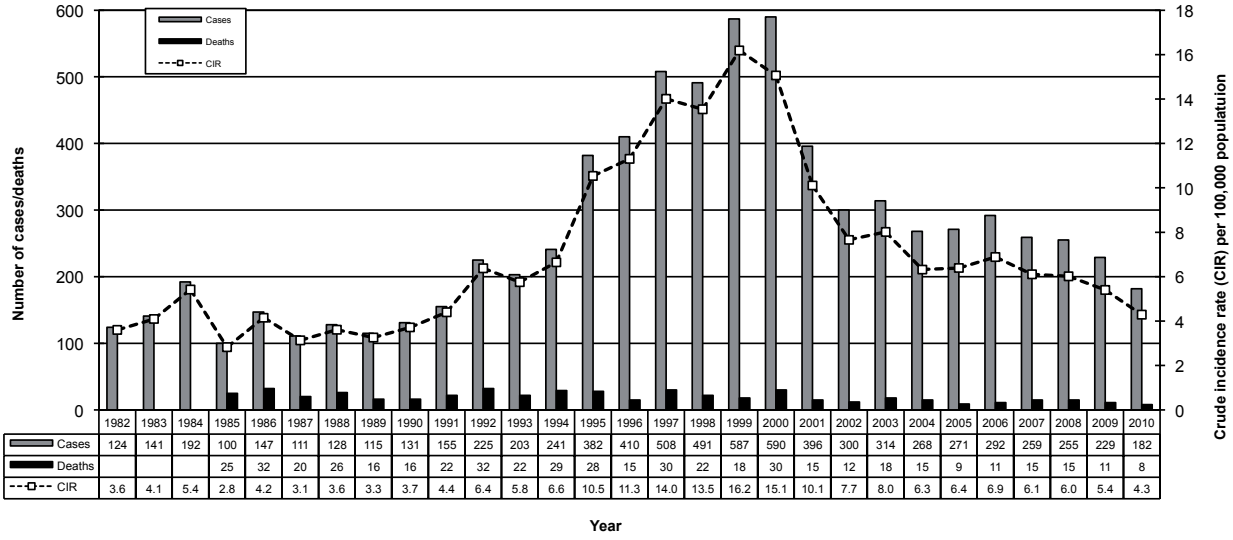
The majority of the data presented in this chapter were extracted from CIDR on the 28th January 2011. These figures may differ from those previously published, due to ongoing updating of more recent notification data on CIDR.

5.4. Bacterial meningitis (including meningococcal septicaemia) – cases and deaths

The incidence of bacterial meningitis in Ireland over the last 29 years has ranged from a minimum of 3.1 per 100,000 total population in 1987 to a maximum of 16.2 per 100,000 total population in 1999 (Figure 5.1). There were a number of reasons for this increase through the mid to late 1990s, such as:

- Increase in the incidence of meningococcal disease in Ireland coincided with increases in the UK and parts of Europe in 1990s.
- Increased awareness/concerns and therefore improved reporting of the disease.
- Establishment of the IMMRL in 1996 resulted in improved and more sensitive diagnostic techniques being used such as nucleic acid detection using PCR. Therefore, cases of meningococcal disease that previously went undiagnosed were now being detected.

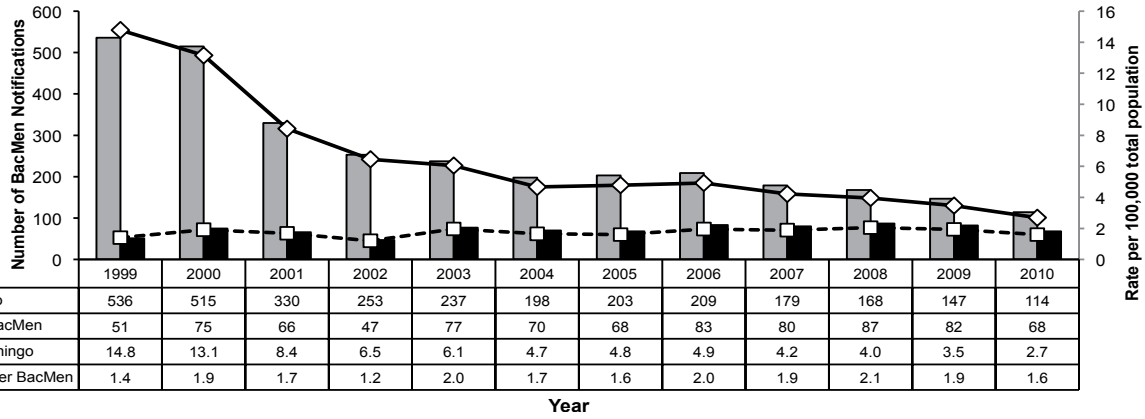
Since the peak in 1999-2000, there has been a steady decline in bacterial meningitis notifications with the annual incidence rate in 2010 standing at 4.3 per 100,000 total population (Figure 5.1). The annual number of deaths due to bacterial meningitis has ranged between eight and 32 between 1985 and 2010 (Figure 5.1). From 1985-1994, the annual case fatality rates (CFRs) for bacterial meningitis always exceeded 10%, ranging between 10.8–25%. Between 1995 and 2004, CFRs due to bacterial meningitis have been <10%, range 3.1-7.3%. In more recent years, CFRs have ranged between 3.3-5.9%.



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cases	124	141	192	100	147	111	128	115	131	155	225	203	241	382	410	508	491	587	590	396	300	314	268	271	292	259	255	229	182
Deaths				25	32	20	26	16	16	22	32	22	29	28	15	30	22	18	30	15	12	18	15	9	11	15	15	11	8
CIR	3.6	4.1	5.4	2.8	4.2	3.1	3.6	3.3	3.7	4.4	6.4	5.8	6.6	10.5	11.3	14.0	13.5	16.2	15.1	10.1	7.7	8.0	6.3	6.4	6.9	6.1	6.0	5.4	4.3

Figure 5.1. Bacterial meningitis (including meningococcal septicaemia) notifications in Ireland, 1982-2010; number of cases, deaths and crude incidence rates

Nationally, some epidemiological data on bacterial meningitis notifications are available since 1997 and detailed case-based data are available since 1999. The majority of these notifications are due to invasive meningococcal disease, accounting for between 63-91% of bacterial meningitis notifications annually (Figure 5.2). A detailed description of the epidemiology of invasive meningococcal disease will be presented in this chapter. Also epidemiological information available on other forms of bacterial meningitis will also be presented. The information presented is based on data received through enhanced surveillance of bacterial meningitis cases (including meningococcal septicaemia). See Appendix 1, for the annual breakdown of the bacterial meningitis figures by causative pathogen (where available).



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Meningo	536	515	330	253	237	198	203	209	179	168	147	114
Other BacMen	51	75	66	47	77	70	68	83	80	87	82	68
CIR Meningo	14.8	13.1	8.4	6.5	6.1	4.7	4.8	4.9	4.2	4.0	3.5	2.7
CIR Other BacMen	1.4	1.9	1.7	1.2	2.0	1.7	1.6	2.0	1.9	2.1	1.9	1.6

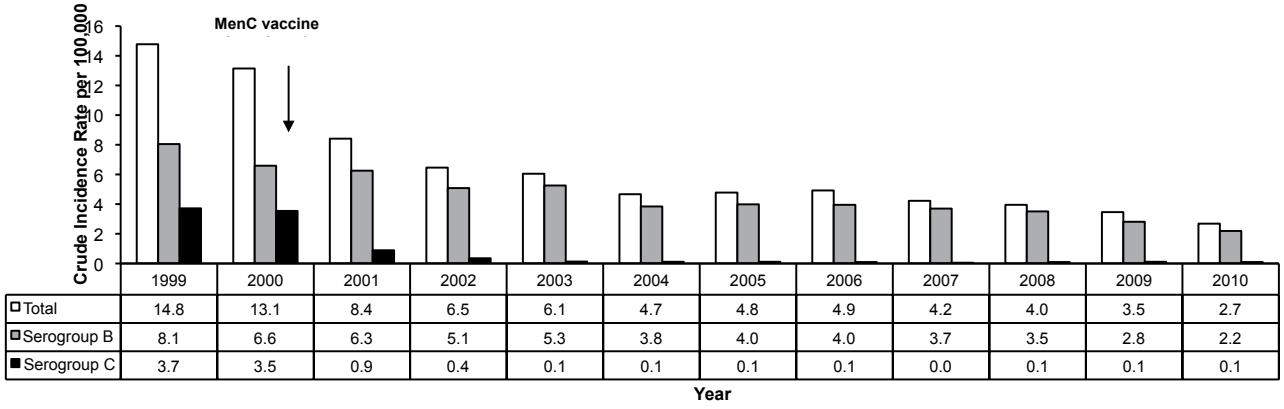
Figure 5.2. Number of invasive meningococcal disease and other bacterial notifications in Ireland, 1999-2010

5.5. Invasive Meningococcal Disease (IMD)

5.5.1. IMD cases

The incidence of IMD increased from 12.4 per 100,000 total population in 1997 and 1998 to 14.8 per 100,000 in 1999. It dropped to 13.1 per 100,000 in 2000 and steadily declined each year after that until it reached 4.7 per 100,000 in 2004. In 2005 and 2006, incidence rates increased very slightly to 4.8 and 4.9 per 100,000, respectively. More recently in 2010, the incidence rate has fallen further to 2.7 per 100,000 (Figure 5.3).

Between 1999 and 2010, *N. meningitidis* serogroups B and C accounted for over 96% of all confirmed cases in Ireland (n=2474/2562) (Table 5.1). Similar to total IMD, the incidence of serogroup B IMD also peaked in 1999 (8.0/100,000 total population). Since then the annual incidence rates have declined somewhat but the magnitude of this decrease has not been the same as that seen for total IMD. The annual incidence rates of serogroup C disease did not fluctuate greatly between 1999-2000, with an average annual rate of 3.6 per 100,000 total population reported. However, since the introduction of the meningococcal group C conjugate (MenC) vaccine in October 2000, the incidence rates of serogroup C disease have plummeted in Ireland with 0.1 cases per 100,000 total population occurring annually on average over the last eight years, 2003-2010 (Figure 5.3).



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	14.8	13.1	8.4	6.5	6.1	4.7	4.8	4.9	4.2	4.0	3.5	2.7
Serogroup B	8.1	6.6	6.3	5.1	5.3	3.8	4.0	4.0	3.7	3.5	2.8	2.2
Serogroup C	3.7	3.5	0.9	0.4	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1

Figure 5.3. Crude incidence rates of invasive meningococcal disease in Ireland, 1999-2010

Table 5.1. Annual number of IMD notifications by serogroup, 1999-2010

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Serogroup B	292	258	245	199	206	163	169	168	157	149	119	93
Serogroup C	135	139	35	14	5	5	5	4	2	4	5	4
Serogroup W_{135}	4	3	3	6	3	1	3	1	2	2	2	1
Serogroup Y	2	4	1	2	2	2	3	4	0	1	4	0
Non-groupable (NG)	12	6	7	1	4	1	2	1	0	1	0	0
No organism detected	91	105	39	31	17	26	21	31	18	11	17	16
Total	536	515	330	253	237	198	203	209	179	168	147	114
CIR*	14.8	13.1	8.4	6.5	6.1	5.1	4.8	4.9	4.2	4.0	3.5	2.7

* Overall crude incidence rate per 100,000 total population

IMD by gender and age

Between 1999 and 2010, a total of 3,089 cases of IMD were notified. More cases occurred in males (55.0%) than in females, giving a male to female ratio of 1.2:1.0. The peak age-specific incidence rates for IMD tends to be in children aged <1 year old (49.1/100,000 in 2010) followed by the 1-2 year olds (27.2/100,000 in 2010). A second peak tends to occurs in adolescents i.e. 15-19 year old age group (4.1/100,000 in 2010). Since 2004, the distribution of cases by age-group has been very similar and the incidence of IMD has declined considerably in infants, children and teenagers when compared with 2000 (Figure 5.4).

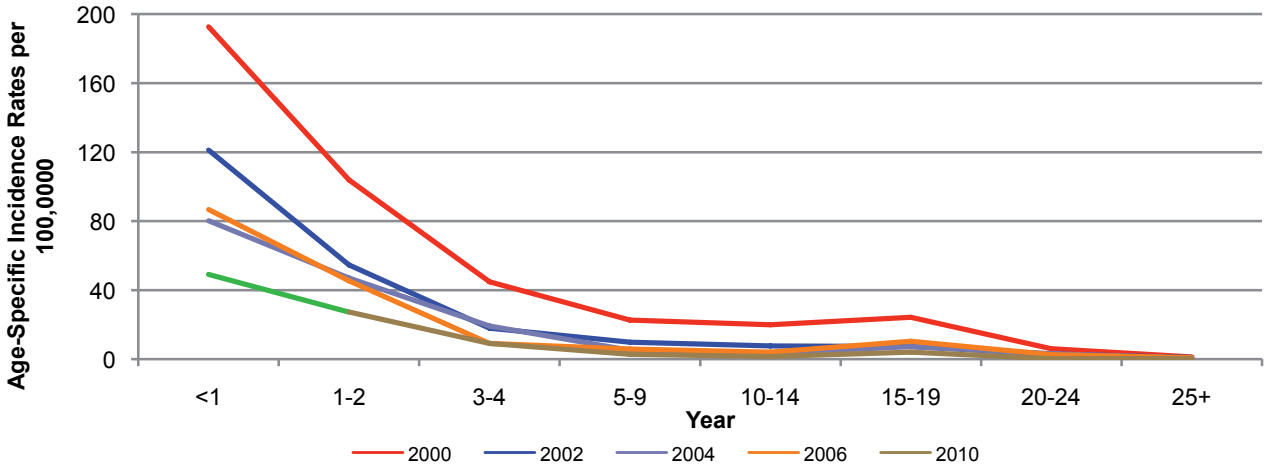


Figure 5.4. Age specific incidence rates of invasive meningococcal disease in Ireland in 2000, 2002, 2004, 2006 and 2010

5.5.2. Impact of the meningococcal serogroup C conjugate vaccine

The meningococcal group C conjugate (MenC) vaccine was introduced in Ireland in October 2000, as part of the primary childhood immunisation schedule at two, four and six months of age. A catch-up programme was also launched at the time offering the vaccine to everyone <23 years of age, a target population of 1.3 million. This was introduced on a phased basis with those most at risk of serogroup C disease being vaccinated first (those <5 and the 15-18 years of age). The catch-up programme was an enormous logistical operation administered by health board immunisation teams who vaccinated the 5-22 year old age-group by visiting schools and colleges and by GPs who vaccinated children <5 years of age. Anyone who did not avail of the vaccine in school/college or was no longer in full-time education could also receive it from their GP. By March 2002, the national catch-up programme was complete.

National uptake of the MenC vaccine in the catch-up programme was 70% overall in those who were aged 1-22 years in 2000. It was highest in the 5-12 year old age group (89%) and 13-17 year old age group (81%). It was lower in the 1-4 year old children (77%) while only 30% of young adults aged 18-22 years availed of the vaccine. Uptake of the MenC vaccine through the childhood immunisation schedule has steadily improved each year since it was introduced and in 2010, it was 89% (two doses) in infants who reached their first birthday and 86% (three doses) in children

reaching their second birthday during that year, see HPSC Annual Report 2010, available at www.hpsc.ie.

Within one year of introducing the MenC vaccine a 75% reduction in the incidence of serogroup C IMD had occurred and by the end of 2003, serogroup C disease had declined by 96% compared with the pre-vaccine era (Figure 5.5). In 2010, just four cases of serogroup C IMD occurred compared to 139 cases in 2000, a 97% reduction (Figure 5.5).

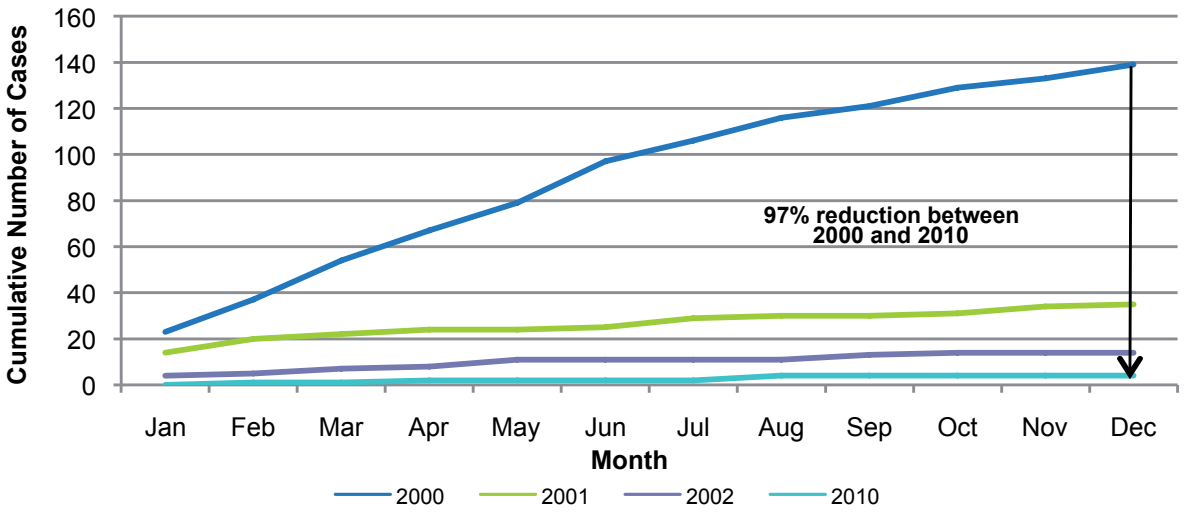
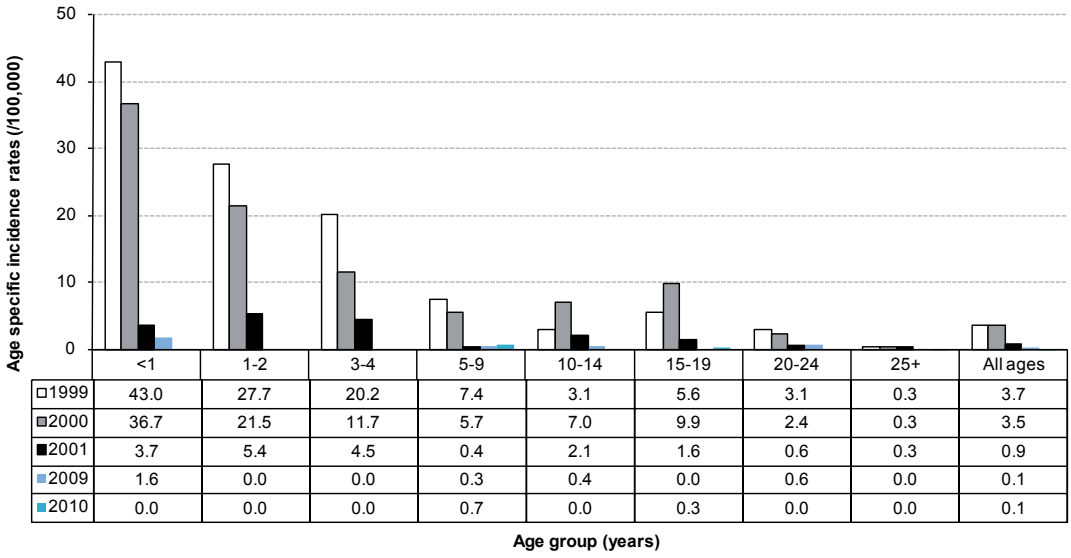


Figure 5.5. Cumulative number of serogroup C IMD cases notified in 2000, 2001, 2002 and 2010

The age-specific incidence rates of serogroup C IMD has declined in all age groups since the MenC vaccine was introduced. The most dramatic reductions have been seen in infants <1 year of age and in children aged 1-2 years (Figure 5.6). In 1999, the age-specific incidence rates for these age groups were 43 per 100,000 total population and 28 per 100,000, respectively, and are now at a rate of zero cases per 100,000 for both age groups. The incidence of serogroup C disease has also declined in adults (≥25 years) from 0.33 per 100,000 in 1999, 2000 and 2001 to 0.04 per 100,000 in 2010 (Figure 5.6). In 2010, two cases occurred in children less than 15 years of age, while two more occurred in adults aged 15 years or more.



	<1	1-2	3-4	5-9	10-14	15-19	20-24	25+	All ages
1999	43.0	27.7	20.2	7.4	3.1	5.6	3.1	0.3	3.7
2000	36.7	21.5	11.7	5.7	7.0	9.9	2.4	0.3	3.5
2001	3.7	5.4	4.5	0.4	2.1	1.6	0.6	0.3	0.9
2009	1.6	0.0	0.0	0.3	0.4	0.0	0.6	0.0	0.1
2010	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.1

Figure 5.6. Age-specific incidence rates of serogroup C invasive meningococcal disease 1999-2001 and 2009-2010.

5.5.3. MenC vaccine failures

A true MenC vaccine failure is the occurrence of serogroup C IMD in an individual despite being fully vaccinated in the past against this form of the disease. An apparent MenC vaccine failure is the occurrence of serogroup C disease in an individual who was incompletely vaccinated in the past.

Since 2001, 83 serogroup C cases of IMD have occurred and in that period there have been nine true MenC vaccine failures and four apparent vaccine failures. Regarding the nine true vaccine failures, one occurred in both 2001 and

2002, one annually between 2005 and 2008 and three in 2009. Four of the true vaccine failures occurred in children aged 1-4 years, four occurred in those aged 5-19 years and one occurred in a 20-24 year old and all survived the illness.

5.5.4. Serotype distribution of serogroup B and serogroup C isolates

Serotyping of IMD isolates is undertaken by the IMMRL. Since over half the confirmed cases of IMD each year are diagnosed by PCR alone, no *N. meningitidis* isolates are available for those cases. However, where isolates are available, they are not universally sent by the source laboratories to IMMRL for serotyping. Of the 2,218 serogroup B IMD cases diagnosed between 1999-2010 serotyping results were available for 613 of these (27.6%). The predominant serogroup B subtypes were 4 and NT (Figure 5.7a). This has consistently been the trend each year over the twelve year period since 1999. *N. meningitidis* B; 4; P1.4 alone accounted for 163 of the 613 (26.6%) serogroup B isolates serotyped. Between 1999 and 2010, 357 cases of serogroup C IMD were diagnosed of which 119 (33.3%) were serotyped. The predominant serogroup C serotype in 1999 and 2000 continued to be the serotype most commonly identified (serotype 2a) in the few cases that do still occur (Figure 5.7b). *N. meningitidis* C; 2a; P1.5, P1.2 alone accounted for almost half (46.2%, 55/119) of the serogroup C isolates serotyped.

Figure 5.7.Chart a

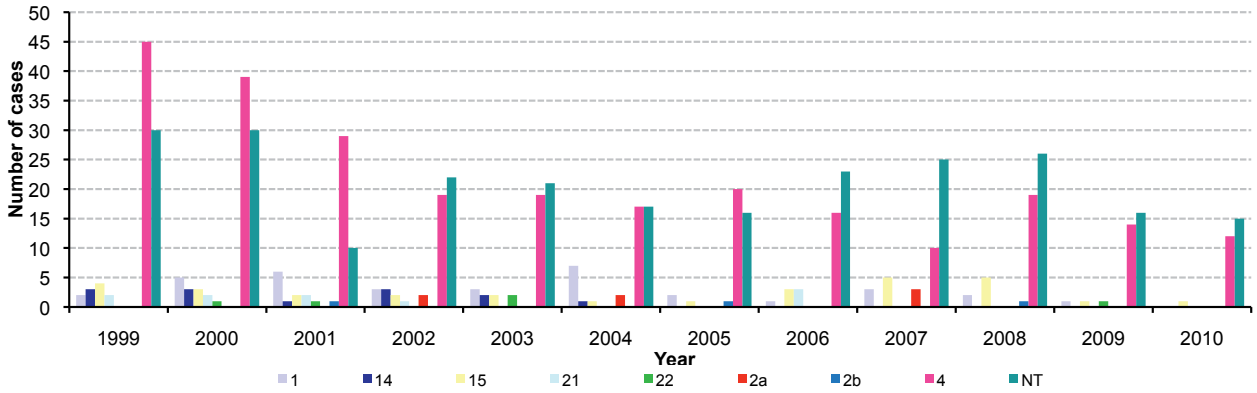


Figure 5.7.Chart b

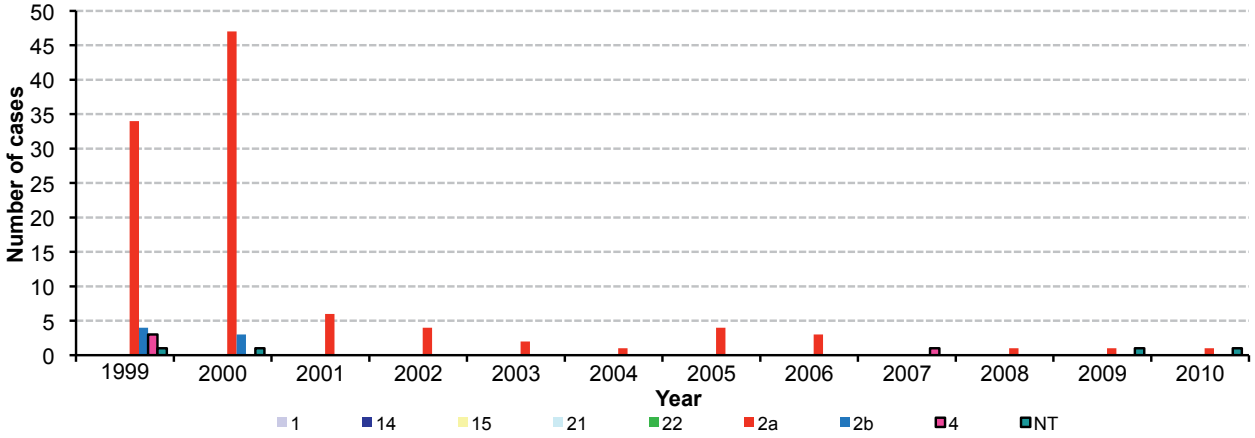


Figure 5.7. Number of serogroup B (chart a) and serogroup C (chart b) isolates by serosubtype, 1999-2010

5.5.5. Invasive meningococcal disease – deaths

The annual numbers of IMD deaths by serogroup, 1999-2010, are presented in Table 5.2. These ranged from 5 to 25 deaths per annum, with case fatality ratios ranging between 2.4% and 5.1%. From 1999-2001, IMD deaths were predominantly due to either serogroup B or serogroup C disease, the two serogroups associated with the greatest proportion of cases. More recently, the number of deaths due to serogroup C IMD has greatly reduced with no deaths occurring in 2002, 2005-2007 or in 2009 or 2010 with just one each in 2003, 2004 and 2008, highlighting the positive impact the MenC vaccine has had in not only reducing serogroup C morbidity but also mortality. Most IMD related deaths are now associated with serogroup B, the serogroup that accounts for the majority of cases. The majority of IMD deaths occur in young children. Over the last nine years (2002-2010), 67 IMD related deaths

occurred, of which 65.7% (n=44) occurred in children <5 years of age. In that same nine year period, three serogroup C deaths occurred, all in middle-aged adults. No young person has died as a result of serogroup C IMD in that time, whereas prior to the introduction of the MenC vaccine between 1999 and 2001 an average of 5.3 deaths per year were occurring in young persons aged <23 years.

Table 5.2. Annual number of IMD deaths by serogroup, 1999-2010

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Serogroup B	12	13	8	8	11	7	5	5	6	6	6	4
Serogroup C	5	11	3	0	1	1	0	0	0	1	0	0
Serogroup W_{135}	0	0	1	0	0	0	0	0	0	1	0	0
Serogroup Y	0	1	0	0	0	0	1	0	0	0	0	0
Non-groupable (NG)	0	0	0	0	0	0	0	0	0	0	0	0
No organism detected	0	0	0	0	0	2	0	0	1	0	0	1
Total	17	25	12	8	12	10	6	5	7	8	6	5
%CFR	3.2%	4.9%	3.6%	3.2%	5.1%	5.1%	3.0%	2.4%	3.9%	4.8%	4.1%	4.4%

* Case fatality ratio, number of deaths/number of case x 100

5.6. *Haemophilus influenzae* meningitis – cases and deaths

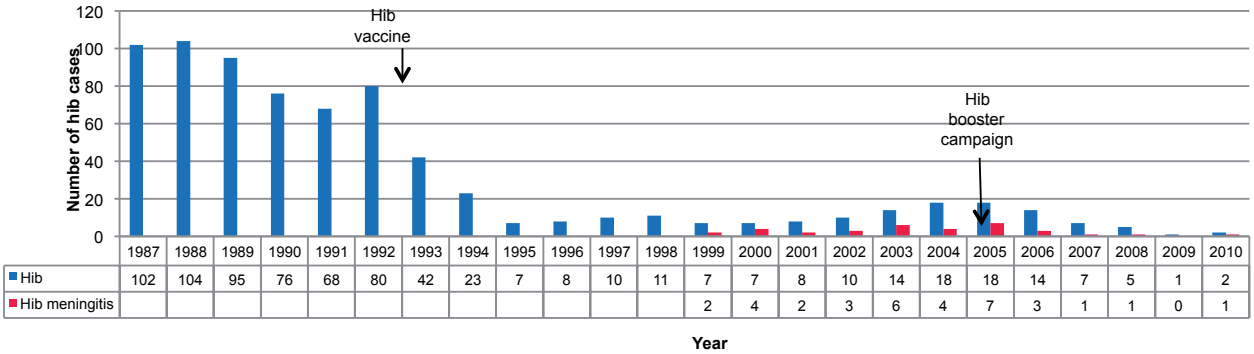
5.6.1. H. influenzae type b meningitis

After the *Haemophilus influenzae* type b (Hib) conjugate vaccine was introduced in 1992, the number of invasive Hib infections declined from over 100 cases per year in the late 1980s to approximately 10 cases per year from the mid 1990s onwards (Figure 5.8). Over the last 12 years (1999-2010) 34 cases of Hib meningitis were reported in Ireland, ranging between one and seven cases *per annum* (Figure 5.8 and Table 5.3). Hib meningitis cases ranged in age from <1 year to 66 years. Eighty-five percent (n=29/34) of these cases occurred in children <3 years of age and all the Hib meningitis cases, with the exception of three, occurred in children aged <5 years (91%, n=31).

No deaths related to Hib meningitis were reported between 1999 and 2010.

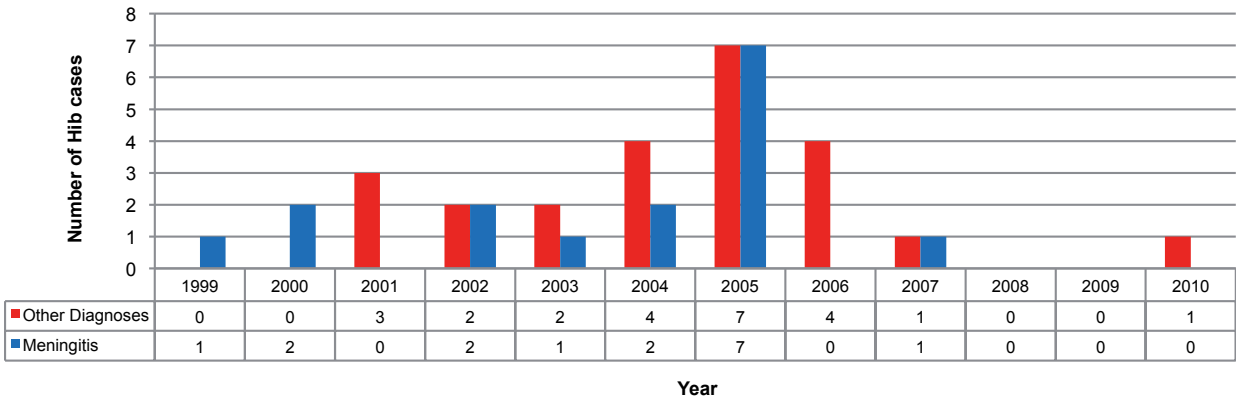
Of the 34 Hib meningitis cases reported between 1999 and 2010, 16 of these (47%) occurred in children who had been fully vaccinated as infants against Hib disease and therefore were considered true Hib vaccine failures (TVFs) (Figure 5.9). These 16 TVFs ranged in age from ten months to four years, with a median age of 1.7 years.

Overall an increase in the number of Hib vaccine failures commenced in Q4-2004 and this increase continued into 2005. In response to this emerging trend the National Immunisation Advisory Committee (NIAC) recommended that a Hib catch-up booster dose be offered to children <4 years of age, in order to further protect this age-group from Hib disease. This catch-up was launched on 21st November 2005 and has been successful in its aims. The number of TVFs has dramatically declined, from 14 in 2005 to one in 2010 (Figure 5.9).



	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Hib	102	104	95	76	68	80	42	23	7	8	10	11	7	7	8	10	14	18	18	14	7	5	1	2
Hib meningitis													2	4	2	3	6	4	7	3	1	1	0	1

Figure 5.8. Number of all invasive *H. influenzae* type b (Hib) cases and Hib meningitis cases reported in Ireland, 1987-2010



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Other Diagnoses	0	0	3	2	2	4	7	4	1	0	0	1
Meningitis	1	2	0	2	1	2	7	0	1	0	0	0

Figure 5.9. Number of true Hib vaccine failures by clinical diagnosis, 1999-2010

5.6.2. H. influenzae meningitis other than Hib

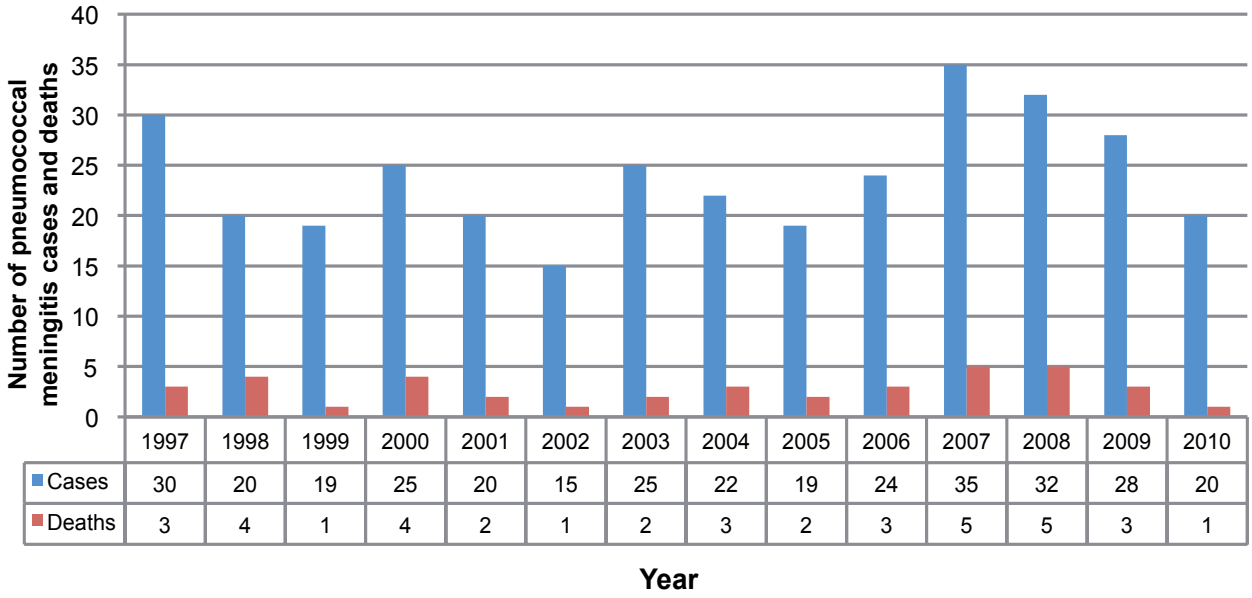
Although Hib accounted for the majority of *H. influenzae* meningitis cases (65%, n=34/52) over the twelve year period between 1999 and 2010, meningitis due to other types of *H. influenzae* also occurred (Table 5.3). One case of *H. influenzae* type e meningitis occurred in a 5-9 year old and four *H. influenzae* type f meningitis occurred in two middle aged adults and in two children less than one year of age. Seven *H. influenzae* meningitis cases due to non-typeable strains occurred over this period, six in children <3 years of age, of which two died. Six cases of untyped *H. influenzae* meningitis occurred in four adults and in two infants <1 year of age during this same period of time (Table 5.3).

Table 5.3. Number of invasive *Haemophilus influenzae* meningitis cases notified by serotype, 1999-2010

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Type b (Hib)	2	4	2	3	6	4	7	3	1	1	0	1
Type e	0	0	0	0	0	0	0	0	0	0	1	0
Type f	0	0	0	0	0	0	1	0	0	2	0	1
Non-typeable	1	1	1	0	1	0	1	1	0	0	1	0
Not typed	2	1	1	0	0	0	0	0	1	0	1	0
Total	5	6	4	3	7	4	9	4	2	3	3	2

5.7. *Streptococcus pneumoniae* meningitis – cases and deaths

Between 1999 and 2010, a total of 228 cases of *Streptococcus pneumoniae* meningitis were notified, approximately 24 cases on average *per annum* (Figure 5.10). The annual case fatality rate varied between 5-16%. From 2004 to 2010, 180 *S. pneumoniae* meningitis cases were notified and ranged in age between 1 week and 86 years, median age 30.6 years. Thirty-six percent of pneumococcal meningitis notifications between 2004 and 2010 were in children aged <2 years (n=65/180) and also in adults ≥50 years of age (n=65). Therefore, young children and older adults accounted for almost 72.2% of the pneumococcal meningitis notifications received since 2004. Twenty-two deaths (12.2%) due to this form of meningitis occurred between 2004 and 2010, of which five (22.7%) were in children <2 years of age and nine (41.9%) were in adults ≥50 years of age.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Cases	30	20	19	25	20	15	25	22	19	24	35	32	28	20
Deaths	3	4	1	4	2	1	2	3	2	3	5	5	3	1

Figure 5.10. Number of pneumococcal meningitis cases and deaths notified, 1997-2010

The pneumococcal conjugate vaccine was introduced to the routine childhood immunisation schedule in 2008. Currently, there is no designated reference laboratory in Ireland for the ongoing typing and genetic characterisation of *S. pneumoniae* strains. Such a service is essential in order to determine baseline distribution of strains prior to the introduction of the vaccine, to assess the impact of the vaccine on IPD morbidity, mortality and serotype distribution, and to measure vaccine effectiveness. All these facets of information are vital on an ongoing basis to inform public health vaccination policy and strategy regarding IPD in Ireland. A pilot pneumococcal typing project commenced in April 2007, a collaboration between the Department of Clinical Microbiology Research at RCSI/Beaumont Hospital, the Children's University Hospital, Temple Street, and the Health Protection Surveillance Centre. Recent data from this project (comparing Jan-December 2008 with the same time period in 2011) has demonstrated a 91% decline in IPD incidence in children <2 years of age, due to serotypes covered by the pneumococcal 7-valent conjugate vaccine (PCV7).

5.8. Neonatal meningitis

Neonatal meningitis is defined as the occurrence of bacterial meningitis within the first 28 days of life. Between 1999 and 2010, 58 cases of neonatal meningitis were reported, with on average 4.8 cases occurring *per annum* (range 1-13 cases) (Table 5.4). In 2010, eight neonatal cases were reported ranging in age from 8-27 days with a median age of 20 days. Three of the eight cases were attributable to *Streptococcus agalactiae* (Group B streptococcus, GBS), one each due to meningococcal disease, *Escherichia coli*, *Streptococococcus* species and *Staphylococcus aureus* and one caused by an unknown organism (Table 5.4). Two neonatal deaths associated with meningitis were reported over this twelve year period, one in 2002, due to *S. agalactiae* in a 3 week old infant and another in 2007, due to *Streptococcus pneumoniae* in a 2 week old.

Table 5.4. Reported neonatal meningitis cases by pathogen and year, 1999-2010

Pathogen	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Streptococcus agalactiae (GBS)	0	0	1	1	1	3	3	2	4	2	2	3	22
Escherichia coli	0	1	0	0	1	0	0	2	0	7	0	1	12
Unknown	0	0	0	1	0	1	0	1	2	0	1	1	7
Neisseria meningitidis	1	0	0	1	1	0	0	1	0	1	1	1	7
Listeria species	0	0	2	0	1	0	0	0	0	1	0	0	4
Streptococcus pneumoniae	0	0	0	0	1	0	0	0	0	2	0	0	3
Salmonella	0	0	0	0	1	0	0	0	0	0	0	0	1
Streptococococcus species	0	0	0	0	0	0	0	0	0	0	0	1	1
Staphylococcus aureus	0	0	0	0	0	0	0	0	0	0	0	1	1
All neonatal cases	**1**	**1**	**3**	**3**	**6**	**4**	**3**	**6**	**6**	**13**	**4**	**8**	**58**

5.9. Tuberculosis meningitis

Tuberculosis meningitis will not be discussed in this report. Guidelines on the Prevention and Control of Tuberculosis in Ireland have been prepared by the National Tuberculosis Advisory Committee, details of which are available at: http://www.hpsc.ie/A-Z/VaccinePreventable/TuberculosisTB/Guidance/.

CHAPTER 6.
LABORATORY DIAGNOSIS OF INVASIVE MENINGOCOCCAL DISEASE

Key points

Antibiotic therapy should not be delayed while initiating, or awaiting results of diagnostic tests

Diagnostic tests for invasive meningococcal disease include:
- Culture of *Neisseria meningitidis* from a normally sterile site
- PCR tests to detect specific meningococcal nucleic acid (blood and CSF)

Additional tests that may be useful include:
- Direct microscopy and demonstration of intracellular Gram negative diplococci (GNDC) in scrapings from a petechial or purpuric lesion
- Culture from non-sterile site (throat, eye) is recommended as adjunct to other samples but is not a diagnostic test
- Serological tests (rarely used)

Epidemiological typing
- Strain differentiation (phenotyping, molecular typing and gene sequencing) is performed at the Irish Meningococcal and Meningitis Reference Laboratory (IMMRL)

Notification of any case of invasive disease causing meningitis should have regard to agreed case definitions under infectious disease regulations

Isolation of the organism or a positive PCR test are the most commonly reported laboratory tests used to confirm disease

6.1. Introduction

Accurate diagnosis is important for public health and epidemiological purposes. When invasive meningococcal disease is suspected on clinical grounds the diagnosis should be confirmed as quickly as possible. However, antibiotic treatment should not be delayed while initiating or awaiting results of diagnostic tests.

Note: At the time of writing these guidelines the Irish Meningococcal and Meningitis Reference Laboratory (IMMRL) which provides a national service for DNA-based diagnosis of invasive disease with *N. meningitidis* and *Haemophilus influenzae* is not resourced to carry out weekend testing. The absence of such a service is seen as a risk and the sub-committee recommend that such a service should be available at weekends.

Isolation of *N. meningitidis* has long been considered as the gold standard. However, meningococci are very fastidious organisms and may fail to grow in laboratory media. In addition, pre-admission antibiotic treatment or treatment before taking samples has led to a further decrease in yield from culture. With the increased use of PCR diagnostic tests (non-culture diagnostic methods) there has been an increase in confirmation of the diagnosis in suspected cases. Between 1999-2009, 57.2% of *N. meningitidis* serogroup B cases and 53.8% of serogroup C cases nationally were diagnosed by PCR only (see Chapter 5 on Epidemiology). In culture negative cases, the lack of data on serotype and serosubtype limits the ability to identify particularly virulent strains in circulation and hinders public health control activities when temporal and geographical clusters are reported. Genetic sequencing directly from the specimen can sometimes yield additional valuable information in culture negative cases but is limited by the quality and quantity of nucleic acid present in the specimen.

6.2. Characteristics of *N. meningitidis* and tests used

N. meningitidis is a Gram-negative, encapsulated, aerobic diplococcus. Thirteen different meningococcal serologic groups (serogroups) have been defined, five of which cause the great majority of disease (A, B, C, Y, and W_{135}). Tests to differentiate serogroups are based on the immunochemistry of the capsular polysaccharide. Polymerase chain reaction (PCR) tests can identify meningococcal DNA even when antibiotics have already been administered and are sensitive and specific. The available PCR tests can differentiate serogroup (A, B, C, Y and W_{135}). Strain differentiation to identify serotypes and serosubtypes is of public health importance in the event of clusters and is used to monitor trends.

6.3. Samples to take for diagnosis

Antibiotic treatment should not be delayed while samples are taken or results are awaited.

The following samples should be taken at the time of initiating treatment in all suspect cases:

- Blood culture
- Throat/pharyngeal swab
- Samples from other sterile sites (as clinically appropriate) e.g. joint, pericardial, or pleural effusions, CSF
- Blood should also be taken for full blood count and PCR testing for meningococcal DNA
- Serology may occasionally be beneficial - consultation with microbiologist should be considered.

Collection of diagnostic samples should still proceed even after administration of antibiotics as these samples may occasionally yield a positive culture and also may be used for non-culture diagnosis using PCR.

Specimens used for the diagnosis of meningococcal infection

- Blood for culture, PCR, serology
- Throat/pharyngeal/eye swab (for culture)
- CSF for microscopy, culture, PCR
- Sample from other sterile site if applicable (joint aspirate) for microscopy, culture, PCR.

Bacteriology

Diagnosis is confirmed by the isolation of *N. meningitidis* from any sterile site or by the demonstration of Gram negative intracellular diplococci in blood, CSF, skin scraping or other sterile site (joint pleural or pericardial fluid). The typical medium to grow the organism is chocolate agar or Mueller-Hinton medium in an atmosphere containing 5% carbon dioxide. Microscopic identification of Gram negative intracellular diplococci from sites such as CSF is highly specific and is considered to provide confirmation of disease. The sensitivity and specificity of the test is determined by adequacy of specimen collection, stage of the disease, use of antibiotics and the experience of the microscopist.

Latex agglutination has been used for rapid detection of meningococcal capsular polysaccharides in CSF, although false-negative and false-positives can occur, Antigen agglutination tests on serum or urine samples are poorly unreliable for diagnosis of meningococcal disease.[36] However, the value of these tests on CSF is influenced by the local meningococcal epidemiology. These tests are of very little value in Ireland and the UK at present as the vast majority of cases of meningococcal infection are with serogroup B and the serogroup B polysaccharide is poorly antigenic and non-reactive in these tests.

PCR testing

The Irish Meningococcal and Meningitis Reference Laboratory (IMMRL) provides a national service for DNA-based diagnosis of invasive disease with *N. meningitidis, H. influenzae (*Hib until 2011, now all serotypes and non-typeable strains) and *S. pneumoniae* and the Group B streptococcus. The methodology utilised is polymerase chain reaction (PCR) detection of specific nucleic acid in a DNA extract from blood, CSF, or other clinical specimens. PCR has been demonstrated to be more sensitive than culture in diagnosis of these infections whether or not antibiotics have been pre-administered. In addition, PCR can detect nonviable organisms and may remain positive in a clinical sample collected up to 96 hours after commencement of appropriate systemic antibiotics and occasionally longer (personal communication IMMRL).

Cerebrospinal fluid (CSF)

Lumbar puncture is recommended for all cases with clinical meningitis, but should be deferred until patient is haemodynamically stable and there are no contraindications (i.e. no evidence of cerebral oedema or raised intracranial pressure (see Chapter 3 on Clinical Management).

The importance of obtaining CSF by lumbar puncture includes identification of the presence or absence of meningitis which may influence the choice and duration of antibiotic treatment and may influence fluid management once the initial shock is treated. Accurate anatomical diagnosis of meningitis is important for epidemiological purposes and the presence or absence of meningitis is very relevant to neurodevelopmental prognosis and possible hearing impairment.[37]

Typically CSF from a case of meningococcal meningitis has a high neutrophil count, low glucose and high protein content. However, low or absent white cells do not exclude meningitis. Initial CSF tests may be normal in approximately 5% of cases.

Gram negative intracellular (neutrophil associated) diplococci confirms a diagnosis of meningococcal meningitis. Prior administration of antibiotics may remove or distort the appearance of the diplococci. The sensitivity of the

Gram stain in CSF is estimated to be approximately 65%. The likelihood of identifying Gram negative diplococci on microscopy is influenced by the stage of disease at the time of obtaining the sample, the number of organisms present, and whether and when antibiotic was already administered.[1]

Aspirates/skin scrapings of skin lesions or from other sterile sites
Aspirates or skin biopsies/scrapings of purpuric or petechial lesions can yield meningococci in cases of meningococcemia. However, a negative result does not exclude invasive meningococcal disease.[38] These tests are no longer recommended in Ireland.

Serum
Acute and convalescent serum antibody tests, although available, are only occasionally used for diagnosis of invasive meningococcal disease. These are based on the demonstration of a single high IgM titre or a rising IgM and/or IgG antibody titres to outer membrane protein antigens. Acute phase serum (5-7 days after onset of symptoms) or paired acute and convalescent sera are required. Serology is not useful for immediate diagnosis and management but may be of public health relevance. If appropriate, the IMMRL will send serum to the SMPRL Stobhill Glasgow for serology testing. Turn-around time is variable and may be a number of months.

Tests used

Gram stain
Gram staining for the identification of *N. meningitidis* is a reliable and rapid method for presumptive identification. Intracellular gram-negative diplococci in CSF can be considered meningococci until proven otherwise. Gram stain of skin lesion aspirates or biopsy specimens has a reported sensitivity of 30% to 70% and is dependent on the presentation, being more sensitive for haemorrhagic lesions. Gram stains of skin biopsies may remain positive for some 48 hours after antibiotic administration (thought to be due to poor penetration of antibiotics into poorly perfused lesions) but the sensitivity at this time is not known. False positive Gram stain results may occur but the frequency has not been defined.

Culture
Blood
Blood for culture should be obtained whenever possible. The sensitivity of blood cultures in IMD depends on many factors such as: how many blood specimens are collected for culture; the volume of sample obtained; prior use of antibiotics; and how promptly the bottles are incubated at 37^{0}C. The sensitivity of blood culture has been estimated at approximately 50% in untreated cases of invasive meningococcal disease, falling to about 5% or less if antibiotics have been used.

Other sterile sites (CSF or other)
Culture of *N. meningitidis* from other sterile sites provides confirmation of invasive meningococcal disease.

The sensitivity of CSF culture is about 95% in cases of untreated meningococcal meningitis. This percentage falls rapidly after treatment. A negative CSF culture does not exclude meningococcal septicaemia without meningitis.

Throat swabs (or pernasal swabs)
Throat swabs yield meningococci in about 50% of invasive meningococcal disease (IMD) cases and are less affected by prior antibiotic therapy. A positive culture supports the diagnosis of IMD but is not definitive evidence. The identification of meningococci on throat swab of a clinically suspect IMD case provides reasonable correlation between a nasopharyngeal isolate and an invasive isolate. The results of the phenotype of a nasopharyngeal isolate from a patient with suspected IMD but negative systemic cultures may be helpful to public health staff in identifying possibly related cases.

Throat swabs from contacts have no value as an aid to diagnosis as the strains carried by contacts are often different from those carried by the cases. Therefore, the taking of throat swabs from contacts is **not recommended**.[39-41]

Technique for obtaining throat swab

- Using a full sweep of the pharyngeal wall and tonsils from all patients
- If not possible, obtain a pernasal swab rotated on the posterior pharyngeal wall

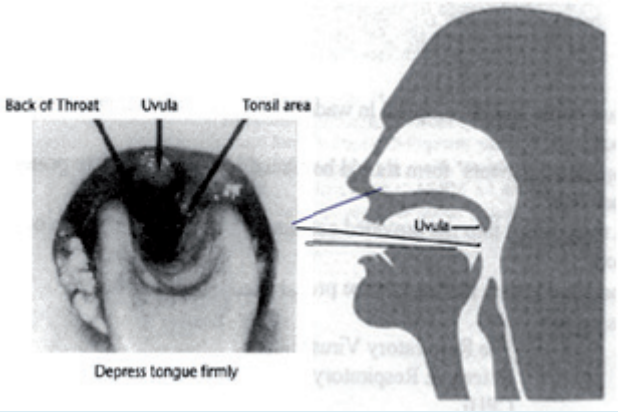


Figure 6.1. Sites for taking throat swabs

Eye swabs
In individuals with clinical signs suggestive of invasive meningococcal disease eye swabs may provide the only isolate of *N. meningitidis* and for such cases this finding is used to define the individual as a 'presumed' case.

Cultures from non-sterile sites may provide the only source of isolate that can be used for strain differentiation and susceptibility testing, and although theoretically may not be the disease causing strain is likely to be so in most cases.

Polymerase chain reaction (PCR)
PCR testing is now commonly used to rapidly diagnose IMD. PCR tests may increase the laboratory diagnosis of cases of meningococcal disease by more than 30% and meningococcal DNA in CSF samples has been detected up to 96 hours after commencement of antibiotic treatment. PCR testing of blood and CSF has a high sensitivity and specificity.

At the IMMRL, an initial meningococcal specific real-time PCR screening assay is performed followed in the case of positives samples by a specific serogrouping PCR assay. The target gene of the initial meningococcal PCR assay employed is the *ctrA* gene which encodes for a highly conserved outer membrane protein (OMP) involved in the transport of capsular polysaccharide. The second/subsequent PCR assay is a real-time serogrouping assay which will amplify serogroup specific sequences within the *siaD* gene which encodes the gene responsible for the polymerisation of sialic acid to the polysialic acid chain. This assay will distinguish between serogroups B, C, Y and W_{135}. Additional PCR tests for 29E, A and X can be performed if required.

The samples of choice for meningococcal PCR are blood (in an ethylenediamine - tetraacetic acid (EDTA) - containing tube) or uncentrifuged CSF.

Positive DNA extracts and isolates received are stored at -80^{0}C and may be *porA* sequence typed for variable regions 1, 2 and 3 which has in many cases yielded information on circulating strains and strain relatedness.

There are no definitive studies on the sensitivity and specificity of PCR assays from skin lesions.

Serodiagnosis
Serological testing, based on an enzyme immunoassay using outer membrane proteins as the antigen, was developed by the UK PHLS Meningococcal Reference Unit (MRU). This methodology is not routinely done in Ireland but if required can be requested by IMMRL, in which case samples are sent to SMPRL Stobhill Glasgow. The test has a sensitivity in excess of 97% in adults and older children (4 years or older) and reactions compatible with a recent meningococcal infection are a positive IgM test in a single sample or seroconversion if paired sera are available. IgM reaches diagnostic levels about 5–7 days after onset, although the precise onset of invasive meningococcal disease is often difficult to determine.

Polysaccharide antigen testing
Polysaccharide antigen testing may be used to demonstrate meningococcal polysaccharide antigen in CSF. However,

antigen tests alone are not reliable as the test has poor sensitivity and specificity. This test is therefore no longer performed in Ireland nor recommended.

Newer test methodologies such as ultrasound-enhanced polysaccharide antigen detection on CSF samples have been evaluated in a number of countries but are not routinely used in Ireland.

A summary of the tests available to diagnose meningococcal disease is seen in Table 6.1.

Table 6.1: Summary of tests available to diagnose meningococcal disease

Test	Specimen	Utility	Sensitivity
Gram stain	CSF, joint fluid or other normally sterile site	Rapid, readily available Positive results confirms diagnosis	CSF: 65% Skin lesions: 30-70%
Culture	Blood, CSF, aspirate from normally sterile site, skin lesion, pernasal or throat swab	Results in 24-48 hours. Positive results confirms diagnosis	No prior antibiotics: CSF: 95% Blood: 50% If prior antibiotics: Blood: 5%
PCR test	CSF, blood	Positive results confirms diagnosis in clinically compatible case; can determine serogroup without culture	CSF/blood: 96% Specificity; up to 100%
Serology	Blood	Not used routinely	
Antigen test	CSF	Not used routinely	

Strain differentiation of *N. meningitidis*

Differentiation of meningococci from cases of invasive meningococcal disease is undertaken for public health reasons, e.g. to confirm or to exclude a suspected outbreak of cases. A true epidemiological link between cases can only be established by public health investigations. Laboratory typing results confirm or exclude such a link, they do not establish one.

A variety of typing techniques is available. One of the most widely used involves characterisation of surface structures in the capsule and outer cell membrane. Capsular polysaccharide antigens can be used to differentiate meningococci into 13 serogroups with A, B, and C accounting for the majority of invasive infections worldwide. Most cases now reported in Ireland are caused by serotype B. Additional serotyping and subtyping can be done by identifying outer membrane or porin proteins (OMPs). There are five different classes of OMPs, some of which are sufficiently different to make them useful for typing. Commonly encountered phenotypes in Ireland are B:4:P1.4 and C:2a:P1.5, P1.2.

Currently all isolates received by the IMMRL are typed to determine the serogroup. The turn-around time is usually rapid (typically a few days). IMMRL use Real Time PCR assays to distinguish between B, C, Y and W_{135}. Positive DNA extracts are *porA* sequence typed for variable regions 1, 2 and 3 (not routine unless specific request to determine relatedness).

Genotyping (molecular) procedures are now used more frequently than the traditional phenotyping (serological typing) methods. A number of methods are used internationally, including pulsed field gel electrophoresis (PFGE), porA/porB sequencing and multilocus restriction typing (MLRT) which involves the restriction fragment-length polymorphism analysis of PCR products generated from the seven loci of housekeeping genes used in multi-locus sequence typing (MLST).

Susceptibility testing

Worldwide, *N. meningitidis* rarely shows resistance to the commonly prescribed antibiotics. In Ireland, antimicrobial susceptibility testing of isolates is recommended and is routinely done on all isolates received by the IMMRL. Occasional reports of decreased susceptibility to penicillin G have been reported from several regions of the USA, Europe and Africa but most of these isolates remain moderately susceptible. Resistance to rifampicin[42] and ciprofloxacin[43] has been reported but are rare. In Ireland, resistance to these antibiotics has not been seen. Both antibiotics may be used in chemoprophylaxis of index cases.

As part of ongoing surveillance antimicrobial susceptibility tests will inform treatment and management of case contacts if resistance does emerge.

CHAPTER 7.
PUBLIC HEALTH MANAGEMENT OF SPORADIC CASES OF MENINGOCOCCAL DISEASE

Key points

- **Nasopharyngeal carriage of meningococci is common:** about 10% of the population carry meningococci at any given time.
- **There is a well established increased risk of further cases among the household contacts, intimate kissing and sexual contacts of a case of meningococcal disease**. Settings where the increased risk is lower than that of household contacts include those in very close contact with a case after the onset of symptoms, and in childcare facilities.
- **The public health response to meningococcal disease includes: identification of close contacts, arranging appropriate chemoprophylaxis and provision of appropriate information.**
- **Chemoprophylaxis is indicated only for those in close contact with a case in the 7 days preceding onset of illness** (see Chapter 9 for details on recommendations for chemoprophylaxis).
- **The main reason for giving chemoprophylaxis is to eliminate meningococci from any carrier who may be in the network of contacts close to each index case.** This reduces the risk to other susceptible individuals in the network, protecting them from acquiring the meningococcal strain from the carrier and possibly invasive disease. Depending on the serogroup of the index case, vaccination with MenC or MenACWY vaccine may be recommended for close contacts.
- **Throat swabs have no role in the public health management of contacts of invasive meningococcal disease.**
- **Local protocols should be developed and agreed between all stakeholders on how to operationalise the guidance on provision of chemoprophylaxis (including out of hours).**

7.1 Transmission and carriage of meningococci

Respiratory droplets shed from the upper respiratory tract transmit meningococci from one person to another. Humans are the only natural hosts for meningococci and the organism dies quickly outside the human host. It is not possible to isolate it from environmental surfaces or samples.

Nasopharyngeal carriage of meningococci is common; about 10% of the population carry meningococci at any given time[44], not all of which are virulent strains. In American and European populations the median duration of carriage has been estimated at between 9 and 10 months.[44,45]

7.2 Chemoprophylaxis

7.2.1 Rationale for chemoprophylaxis

About 97% of cases are sporadic.[46] Contrary to popular belief, a patient with meningococcal disease is not an efficient transmitter of the meningococcus that is causing their illness. Instead it is the carrier who transmitted the organism to the patient in the first instance who is much more likely to transmit the meningococcus again and cause further cases.

Chemoprophylaxis aims to reduce the risk of invasive disease by eradicating carriage in the group of close contacts at highest risk. It may act in two ways: (i) by eradicating carriage from established carriers who pose a risk of infection to others and (ii) by eradicating carriage in those who have newly acquired the invasive strain and who may themselves be at risk. It has been reported that the risk of meningococcal disease in household contacts of a patient can be reduced by an estimated 89% if they take chemoprophylaxis[47] and to prevent one case about 200 household contacts need to be treated.

Chemoprophylaxis should be given to all identified as close contacts as soon as possible (ideally within 24 hours) after notification of the index case. However, it can be given up to a month after onset of illness in the index case.

Local protocols should be developed and agreed between all stakeholders on how to operationalise the guidance on provision of chemoprophylaxis (including out of hours). Each incident requires a careful risk assessment in order to guide the decisions regarding which contacts require chemoprophylaxis.

7.3. Defining close contacts

Throat swabs are of no value in determining who, among a case's close contacts, is the carrier of the implicated meningococcus. A single negative throat swab is unreliable for predicting the absence of meningococcal carriage.[44] Pragmatic decisions, based upon the known risks of further cases, have to be made in defining the network of contacts (of a case) that is likely to include the meningococcal carrier. The risk of further cases of meningococcal disease may be increased in certain discrete settings where close and prolonged contact with a carrier can occur.

7.3.1. Household type contacts of a case

Although the risk to contacts is low, the highest documented absolute and relative risk is to people who live in the same household as a case of meningococcal disease.[46-47] A household is defined as one person living alone or a group of people who share common housekeeping or a living room. The risk is highest in the first seven days after onset of symptoms in the index case and falls rapidly during the following weeks.[46] If prophylaxis is not given, the absolute risk to an individual in the same household of developing meningococcal disease one to 30 days after the index case is about one in 300. [46,47, 48] Beyond this four week period the risk is probably close to background levels.[46] The increased risk in household members may be due to a combination of genetic susceptibility in the family, increased exposure to virulent meningococci and environmental factors.

The case is likely to have acquired the invasive strain from a close contact, typically in the same household, who is an asymptomatic carrier.[45,50] The incubation period is usually three to five days [51,52] and cases do not usually have detectable carriage until admission to hospital or shortly beforehand.[53] As the highest risk of illness in untreated households is observed in the first 48 hours after onset of disease in the index case,[47] the source of infection in these further cases is most likely to be from the same (or another) carrier and not from the case.

Recommendation: Prophylaxis indicated for household type contacts

Chemoprophylaxis should be offered, irrespective of vaccination status, to those who have had prolonged close contact with the case in a household type setting during the seven days before onset of illness. Examples of such contacts would be those living and/or sleeping in the same household (including recent visitors who have stayed overnight), pupils in the same dormitory, boy/girlfriend, or university students sharing a kitchen in a hall of residence. Babysitters may also be included, depending on the level of contact.

Chemoprophylaxis should be considered if, during the seven days before onset of illness, the index case (adult or child) attended a house party for 4 hours or more with children less than 5 years of age. If chemoprophylaxis is indicated, it should be offered to all attendees, both adults and children, who attended for four hours or more.

Special consideration should be given to situations in which there is greater than usual interactions between members of the extended family and an index case, particularly where overcrowded living conditions exist.

7.3.2. Pre-school childcare facilities contacts of a case

A study[54] in England and Wales from 1995 to 2001 analysed the risk of clusters of disease in pre-school settings (including day care, play-groups and other pre-school groups) based on surveillance data. The relative risk of a cluster was 27.6 in pre-school, compared with 5.4 in primary school and 3.6 in secondary school. In the pre-school setting, the absolute risk (excluding 0-1 days) was estimated as 1/2000 and about 70 preschool groups would need to be treated to prevent one cluster.

In October 2010 ECDC issued a guidance document – *Public Health Management of Sporadic Cases of Invasive Meningococcal Disease and their Contacts*.[2] The purpose of the document was to provide evidence-based guidance for good practice in public health management of sporadic cases of invasive meningococcal disease (IMD) and their contacts. Among the questions addressed were – *Should chemoprophylaxis be given to children or students who*

attend the same pre-school, school or college as a case of IMD? The expert group reviewed the available evidence and made a weak recommendation that: ***"Attending the same pre-school as a case of IMD is an indication for chemoprophylaxis, depending on risk assessment" (ECDC).*** They also concluded that a risk assessment in the pre-school setting that takes into account duration and closeness of contact may assist decision making. "The risk of further cases is considered higher in settings similar to households where there would be a higher risk of exposure to respiratory droplets. Children in the same group as the index case who have spent long periods of time in the same room (e.g. fulltime attendance, sharing meals, napping together) are likely to be at higher risk than children in a different group or with contact to the index case that is less direct (e.g. free play versus fixed seating) or of shorter duration (e.g. part-time attendance)." [2]

The Australian guidance on public health management of meningococcal disease recommends chemoprophylaxis for contacts in "child care involving a group staying together in a single room for a four-hour session"[1]

Recommendation chemoprophylaxis for pre-school contacts
Attending the same pre-school as a case (child or staff) of IMD is an indication for chemoprophylaxis, depending on risk assessment.

Following risk assessment chemoprophylaxis should be considered (for children and staff) in the following circumstances:

- **Family pre-school daycare** (where groups of children are cared for in a private home), during the seven days before onset of illness.
- **Pre-school childcare involving a group staying together in a single room** for at least a four-hour session, during the seven days before onset of illness.
- **Pre-school childcare involving a group staying together in a single** room for at least a three-hour session on more than one day, during the seven days before onset of illness. In this situation, chemoprophylaxis may be considered if the setting is similar to a household, e.g. if the children share meals and nap together.

7.3.3 Primary or secondary schools contacts of a case
The ECDC guidance document – Public Health Management of Sporadic Cases of Invasive Meningococcal Disease and their Contacts[2] reviewed the evidence and concluded that the risk difference was much higher in pre-school settings than in school settings. The report states that "if chemoprophylaxis in educational settings was as effective in risk reduction as in households, the number of contacts that would need to be treated to prevent one subsequent case based on the studies analysed in this review would vary from 1,930 (95%CI 1,262-4,116) in pre-school settings to 27,405 (95%CI 19,372-48,851) in school settings, compared to a pooled estimate of 304 in household settings (95%CI 89-564)." The expert group reviewed the available evidence and made a weak recommendation that ***"Attending the same school/college (including the same class) as a case of IMD is not in itself an indication for chemoprophylaxis"***.[2]

Recommendation regarding chemoprophylaxis in schools

- Chemoprophylaxis is not routinely recommended for class contacts of a single case in primary or secondary school, unless they fit criteria for close contacts.

7.3.4 Universities (or other tertiary education facilities) contacts of a case
Although the incidence of meningococcal disease in college students in the United States does not seem to be greater than that in the general population of the same age [55] this is not the situation in the United Kingdom where the incidence is certainly greater in university students. [56] In the latter study, disease rates were shown to be highest in students, often in their first year, living on campus.

The absolute risk of a university or college student in England and Wales becoming a case in the month after the diagnosis of an index case in the same university or college has been found to be very low.[46]

Recommendation regarding chemoprophylaxis in universities (or tertiary facilities)

- When sporadic cases occur in a college setting, chemoprophylaxis is only recommended for contacts who fit the criteria of being close contacts.

7.3.5 Healthcare worker contacts of a case

Healthcare workers in contact with cases of meningococcal disease are at increased relative risk of disease in the 10-day period after exposure, although absolute risks are very low; one study absolute risk was estimated at 0.8 per 100,000 healthcare workers at risk, which is 25 times that in the general population.[57] The data were consistent with a higher (but unquantifiable) risk in those heavily exposed to nasopharyngeal secretions of cases around the time of admission to hospital. After starting treatment with intravenous benzylpenicillin, carriage rates decrease rapidly so that meningococci are undetectable by nasopharyngeal swabbing after 24 hours of treatment.

Recommendation regarding chemoprophylaxis among HCWs

- Chemoprophylaxis is recommended only for those whose mouth or nose is directly exposed to large particle droplets/secretions from the respiratory tract of a probable or confirmed case of meningococcal disease during the acute illness until the case has completed 24 hours of systemic antibiotics. This type of exposure will only occur among staff who are working close to the face of the case without wearing a mask or other mechanical protection. In practice this implies a clear perception of facial contact with droplets/secretions and is unlikely to occur unless using suction during airway management, inserting an airway, intubating, or if the patient coughs in your face. General medical or nursing care of cases is not an indication for prophylaxis.

- Pathologist and pathology technicians who may be exposed to aerosols during the performance of an autopsy should receive chemoprophylaxis when a face mask had not been worn and when the deceased patient did not receive antibiotics for a minimum of 24 hours antemortem.

Exposure of the eyes to respiratory droplets is not considered an indication for prophylaxis. Such exposure may however, carry a low risk of meningococcal conjunctivitis and subsequent invasive disease. Staff should be counselled about the risk and advised to seek early treatment if conjunctivitis should develop with 10 days of exposure.

7.3.6. Index case

The ECDC guidance document – *Public Health Management of Sporadic Cases of Invasive Meningococcal Disease and their Contacts* [2] reviewed the evidence and concluded that "the recommendation to give chemoprophylaxis should apply to all cases of IMD unless they have already been treated with an antibiotic (such as ceftriaxone or cefixime) that eradicates carriage. However, when other third generation cephalosporins are administered to inpatients, the recommendation may be considered weak." There is also a comment that "for cephalosporins such as cefotaxime which are often used in case treatment, it would be useful to evaluate their effectiveness in carriage eradication."

Recommendation regarding chemoprophylaxis for index case

- The index case should be given chemoprophylaxis when able to take oral medication and before discharge from hospital, unless the disease had already been treated with ceftriaxone (or cefixime).

- When the disease has been treated with cefotaxime it may be prudent to give chemoprophylaxis until studies are available on its effectiveness in eradicating carriage.

7.3.7 Those who may have shared saliva with a case

Saliva contains other bacteria that are able to inhibit the growth of meningococci, and consequently meningococci are not easily isolated from saliva.[44] The ECDC guidance document – *Public Health Management of Sporadic Cases of Invasive Meningococcal Disease and their Contacts* [2] reviewed the evidence regarding the risk to people who have

shared drinks with a case of IMD. They concluded that it is important to "distinguish between salivary contact and respiratory droplet contact. *Neisseria meningitidis* colonises the posterior pharyngeal wall and is transmitted through respiratory droplets. In practice, some contact activities may involve both. For example, activities such as intimate (mouth-to-mouth) kissing are likely to involve both an important exchange of saliva and also an important exchange of respiratory droplets and have been linked to increased risk of carriage and disease. However, activities such as sharing drinks and cigarettes may occur in the absence of close contact." The expert group reviewed the available evidence and made a weak recommendation that ***"Sharing drinks or cigarettes or similar contact with a case of IMD is not in itself an indication for chemoprophylaxis".***[2]

Recommendation regarding chemoprophylaxis in relation to salivary exposure:

- Prophylaxis is not indicated for individuals who have had low risk salivary exposures unless already identified as close household type contact.
- Prophylaxis is indicated for intimate mouth to mouth kissing contacts during the seven days before onset of illness.

7.3.8 People exposed to a case while traveling.
Transient contact with the index case before acute illness is unlikely to be an important risk factor for disease, so that mere proximity to the case (e.g. during travel in a plane, bus or car) may not justify prophylaxis. The ECDC guidance document – *Public Health Management of Sporadic Cases of Invasive Meningococcal Disease and their Contacts* [2] reviewed the evidence and concluded that the quality of evidence for or against giving chemoprophylaxis to contacts who shared the same transport vehicle as a case of IMD is very low. The lack of clusters in the published literature suggests that the risk to contacts in these situations is very low. The expert group reviewed the available evidence and made a weak recommendation that ***"Sharing the same transport vehicle as a case of IMD is not in itself an indication for chemoprophylaxis".***[2]

Recommendation regarding chemoprophylaxis for fellow travellers:

- Prophylaxis is not indicated for those who shared the same transport vehicle (e.g. plane, boat, bus, car) as a case unless already identified as close household type contact.

7.3.9. Post mortem exposure to a case
The national document, "*Guidelines on Management of Deceased Individuals Harboring Infectious Diseases*" for publication in 2012 by a sub-committee of the Scientific Advisory Committee of HPSC [58] states that for meningococcal disease "the risk of transmission from human remains in a funeral setting is extremely low". Therefore, in the case of meningococcal disease there is no indication for precautions other than standard precautions in this setting.

Recommendation regarding chemoprophylaxis following post mortem exposure

- Post mortem contact with a case is not an indication for prophylaxis.
- Kissing the body is not considered to be a risk. Body bags are not necessary unless otherwise indicated, e.g. as a practical measure to facilitate lifting or moving. Transport to other countries for burial or cremation does not pose a risk. There is no restriction on embalming.

Summary of key recommendations for chemoprophylaxis

Risk assessment is needed
For each notification of meningococcal disease, an individual event-specific risk assessment is needed to determine which individuals in contact with the case should be considered as "close contacts" and for whom chemoprophylaxis is therefore indicated.

Prophylaxis generally indicated
Chemoprophylaxis should be offered/considered for those who had **close prolonged contact** with a case in the seven days before onset of illness, irrespective of vaccination status, in the following categories:

Household type contacts
All household type contacts should be offered chemoprophylaxis. Examples of such contacts would be those living and/or sleeping in the same household (including recent visitors who have stayed overnight), pupils in the same dormitory, boy/girlfriend, or university students sharing a kitchen in a hall of residence. Babysitters may also be included depending on the level of contact.

Intimate contacts
Intimate mouth to mouth kissing contacts should be offered chemoprophylaxis.

Attendance at house party - in certain circumstances
Following risk assessment chemoprophylaxis should be considered if the index case (adult or child) attended a house party for four hours or more with children less than 5 years of age. If chemoprophylaxis is indicated it should be offered to all attendees, both adults and children, who attended for four hours or more.

Other situations with possible close contact
Special consideration should be given to situations in which there is greater than usual interactions between members of the extended family and an index case, particularly where overcrowded living conditions exist.

Preschool child-care facilities contacts in certain circumstances
Following risk assessment chemoprophylaxis should be considered in the following circumstances:
- **Family pre-school day care** (where groups of children are cared for in a private home)
- **Preschool childcare**
  - -involving a group staying together in a single room for at least a four-hour session.
  - -involving a group staying together in a single room for at least a three-hour session on more than one day. In this situation chemoprophylaxis may be considered if the setting is similar to a household, e.g. if the children share meals and nap together.

Healthcare workers in certain circumstances
Chemoprophylaxis is recommended only for those whose mouth or nose is directly exposed to large particle droplets/secretions from the respiratory tract of a probable or confirmed case of meningococcal disease during acute illness until the case has completed 24 hours of systemic antibiotics. This type of exposure will only occur among staff who are working close to the face of the case without wearing a mask or other mechanical protection. In practice this implies a clear perception of facial contact with droplets/secretions and is unlikely to occur unless using suction during airway management, inserting an airway, intubating, or if the patient coughs in your face.

Index case
Chemoprophylaxis is recommended when able to take oral medication and before discharge from hospital, unless the disease had already been treated with ceftriaxone.

Note: Key recommendations are continued next page

Summary of key recommendations for chemoprophylaxis (continued)

Prophylaxis generally not indicated
Prophylaxis is generally not indicated for contacts of a sporadic case in the following categories unless already identified as close contacts:

- Primary or secondary school contacts
- General medical or nursing care of a case
- Work colleagues
- Friends
- Residents of a nursing home/residential homes
- Kissing on cheek or mouth (intimate mouth-to-mouth kissing contacts should be offered prophylaxis)
- Food or drink sharing or similar low level of salivary contact
- Travelling in next seat on same plane, train, bus or car
- Post mortem contact with a case (other than performing an autopsy when may be indicated if exposed to aerosols and not wearing a mask).

Timing of prophylaxis
Ideally, chemoprophylaxis should be given to all contacts as soon as possible after diagnosis of a case. However, it is appropriate to administer chemoprophylaxis to close contacts who may not have come to notice initially, up to a month after the identification of the index case as carriage may persist for a long period.

7.4 Public health actions after a case

Risk assessment is needed
For each notification of meningococcal disease, an individual event-specific risk assessment is needed to determine which individuals in contact with the case should be considered as "close contacts" and for whom chemoprophylaxis is therefore indicated.

7.4.1 Cases requiring public health actions
Public health actions should commence as soon as possible in all cases where the clinical diagnosis of meningococcal meningitis or septicaemia is considered the most likely diagnosis. (See section 7.5)

Although not meeting the case definition of a confirmed, probable or possible case, meningococcal infection of the conjunctiva, without clinical evidence of sepsis, is considered an indication for public health action because it may precede invasive disease[59] or invasive meningococcal disease in a contact.[15] (See section 7.5)

7.4.2 Cases not requiring public health actions
When the public health doctor, in consultation with the clinician managing the case considers that diagnoses other than meningococcal disease are at least as likely, then chemoprophylaxis is not indicated. This category includes cases treated with antibiotics whose probable diagnosis is viral meningitis. If further evidence emerges to change the diagnosis then appropriate actions should be taken.

Isolation of meningococci from sputum or from swabs taken from nasopharynx or genital tract, in the absence of clinical evidence of sepsis, is not by itself an indication for public health action as asymptomatic carriage in the respiratory and genital tract is common.

Meningococcal pneumonia is not an indication for public health action but may carry a low risk of transmission in healthcare settings especially to the immunocompromised.[3]

7.5 The public health response

The public health response should be implemented as soon as possible, and includes the following actions:

- Identification of close contacts.

  (The designated medical officers of health (MOH) under Infectious Disease Regulations [34] have the authority and obligation to "make such enquiries and take such steps as are necessary or desirable for investigating the nature and source of such infection, for preventing the spread of such infection and for removing conditions favourable to such infection". Under these same regulations, "a person who refuses to comply with a requirement or direction given or a request for information made in pursuance of any of the provisions of these Regulations shall be guilty of a contravention of these Regulations").
- Arranging appropriate chemoprophylaxis to those identified as requiring prophylaxis.
- Provision of appropriate information.

7.5.1 Dissemination of information

Following a case of meningococcal disease, it is important to give out information because early diagnosis and treatment should improve outcome. There is a small but real risk of further linked cases.[46] Vigilance for signs and symptoms among contacts is important especially in the immediate high risk period (one week) after onset of symptoms in a case. Accurate and timely information should help limit the spread of false rumours and anxiety and to some extent allay public concern.

Information should be sufficient to ensure awareness of the situation whiles preserving patient confidentiality.

The family of a case should be informed that information will be distributed as appropriate. Leaflets or other printed material about meningococcal disease should be widely available and quickly distributed after reporting of a confirmed or clinical case. Examples of information sheets can be found in the Appendix of these guidelines.

Information to those given chemoprophylaxis should include:

- Symptoms and signs of the disease and the need to seek urgent medical advice should they become unwell
- Chemoprophylaxis does not exclude the possibility, although small, of a person developing meningococcal disease
- There is no need for an asymptomatic person who is taking chemoprophylaxis to be 'quarantined' in any way

Recipients should be given this information at the time of receiving chemoprophylaxis. This information is covered in the example sheets at the back of the document (see Appendix for examples).

Consider the need to inform other HSE colleagues, GPs and GP out-of-hours services about the case and what public health actions have been taken or are required.

When a case occurs in a childcare facility the manager should be informed. The information should be sufficient to ensure that other parents are aware of the situation whilst preserving the confidentiality of the patient. Arrangements should be made to provide information for all the parents and, if indicated, chemoprophylaxis for those identified as close contacts.

When a case occurs in a school or college the principal/head should be informed. Arrangements should be made to provide information for other parents/students. The information should be sufficient to ensure that parents/students are aware of the situation whilst preserving the confidentiality of the patient.

If a suspected case occurs in a childcare or educational facility and public health action is not immediately indicated (e.g. a case considered that diagnoses other than meningococcal disease are at least as likely) it may still be advisable to discuss the situation with the manager/head at an early stage. The manager/head will then be in a good position to respond immediately to parental concerns.

7.5.2 Vaccines

Meningococcal serogroup C conjugate vaccine (MenC)

Meningococcal serogroup C conjugate vaccine (MenC) was introduced into the Irish childhood immunisation programme in October 2000 and a catch-up programme was provided to all children and young adults up to the age of 23 years. The vaccine confers high levels of serum bactericidal antibody and induces immunological memory in individuals from the age of two months.[60] Preliminary estimates of vaccine efficacy suggest that the vaccine is 88-96% effective against invasive meningococcal disease due to serogroup C infection. Protection declines over time especially when given under 1 year of age.[61]

Previous serogroup C disease is not a contraindication to MenC vaccination. The immune response to natural infection may be inferior to that observed after conjugate vaccines [62], particularly in young children.

Meningococcal serogroup B vaccine (MenB)
This is a recombinant multicomponent meningococcal B vaccine (Bexsero). It is indicated for active immunisation of individuals from 2 months of age and older against invasive meningococcal disease caused by *Neisseria meningitidis* group B. There are no data on its use in adults older than 50 years of age, but it is recommended for at-risk persons aged over 50 years. Two to three doses are recommended.

This vaccine was introduced into the routine national childhood immunisation programme in October 2016.

Conjugate quadrivalent ($ACW_{135}Y$) vaccine
Two conjugate MenACWY vaccines made from group A, C, W and Y capsular polysaccharides are available. The protein conjugates are either CRM197 (Menveo) or tetanus toxoid (Nimenrix). One to two doses are recommended. See Immunisation Guidelines for Ireland for details on doses required.

Note: Vaccination should be according to the current Irish Immunisation recommendations[35], which are updated regularly. Please see NIO website for most recent updated information (http://www.immunisation.ie).

7.6 Immunisation recommendations for index case and close contacts

7.6.1 Serogroup A, W, or Y disease
MenACWY vaccine is recommended for index cases to provide protection against all four serogroups, even though recurrent meningococcal infection is rare.

For an index case who received MenACWY vaccine more than 12 months previously a booster dose may be indicated following consultation with relevant specialist.

7.6.2 Serogroup B disease
MenB vaccine is recommended for index cases of any age who have not previously received MenB vaccine.

7.6.3 Serogroup C disease
MenC vaccine is recommended for index cases unless they have an increased risk of disease, in which case MenACWY is indicated.

See Immunisation Guidelines for Ireland for detail on vaccine and doses.

7.7 Immunisation recommendations for close contacts

Close contacts of cases of meningococcal infection have an increased risk of developing the disease in subsequent weeks and so should be given appropriate vaccination as below:

7.7.1 Serogroup A, W or Y disease.
MenACWY vaccine is recommended for all close contacts of any age, in addition to chemoprophylaxis. Depending on the age of the close contact one or two doses may be indicated.

Those who received the conjugate MenACWY vaccine more than 12 months previously should be considered for a booster dose if at ongoing risk of meningococcal infection.

7.7.2 Serogroup B disease
In addition to chemoprophylaxis, immunisation with MenB vaccine is recommended for all previously unimmunised close contacts of meningococcal B disease.

7.7.3 Serogroup C disease
MenC vaccine is recommended for all previously unimmunised close contacts from 6 weeks of age in addition to chemoprophylaxis. Close contacts who are partially immunised should complete the course of vaccine.

Those who completed a course more than one year before should be offered a booster.

See Immunisation Guidelines for Ireland for detail on vaccine and doses.

Recommendation

Depending on the serogroup of the index case, vaccination with MenC, MenB or MenACWY vaccine may be recommended for index case and close contacts

7.8 Vaccine failures

Vaccine failure implies an inadequate response to the vaccine and may reflect host factors or sub-optimal storage or administration of the vaccine. All vaccine failures should be reported to HPSC as part of the ongoing monitoring of the MenC and MenB programmes. Additionally a sample of convalescent serum prior to re-immunisation should be taken and sent to the IMMRL who will forward the sample to the Public Health England Meningococcal Reference Unit (MRU) for further analysis. The IMMRL contact the clinician directly to arrange the sample.

CHAPTER 8.
MANAGEMENT OF CLUSTERS/ OUTBREAKS OF MENINGOCOCCAL DISEASE

Key points

- **The objective of public health management of outbreaks is to interrupt the transmission of disease and prevent further cases occurring.**
- **Clusters/outbreaks may be institution or organisation based or community based.**

8.1 Definitions

An institution or organisation based outbreak of meningococcal disease:
Two or more definite cases of meningococcal disease within a four-week period in a group with epidemiological links, AND where the available microbiological characterisation of the organisms is the same.

A community based outbreak:
Consider intervention if the age specific attack rate is "high". Although a precise threshold for intervention has not been set, age-specific attack rates should be calculated. A minimum of four cases of definite meningococcal disease within a three-month interval, or 40/100,000 in any age group in a three-month period, in a geographical area that makes epidemiological sense AND where available microbiological characterisation of the organisms is the same.[3]

Decisions regarding chemoprophylaxis and vaccination (if appropriate) for a wider group than solely close contacts is dependent on local risk assessment.

Easy to understand written information should be provided to all individuals regarding control measures taken (or not), early warning signs and contact details for follow-up advice.

8. 2 Introduction

Outbreaks may occur in the general community or in other settings such as schools and universities. The public health actions for each of these settings may vary and will depend on the identification of epidemiological links between cases and identification that the same organism is associated with the outbreak cases.

Outbreaks of invasive meningococcal disease need to be distinguished from increases of sporadic and epidemiologically unlinked cases. Such increases may occur in the general community or within settings such as schools and crèches.

When clustering of cases occurs local public health should look for epidemiological links between cases, even if these are not immediately evident. Identification of such epi-links will inform and direct public health control activities.

The objective of public health management of such outbreaks of invasive meningococcal disease is to interrupt transmission and prevent further cases. Once an outbreak is either suspected or recognised there is an immediate need to initiate a coordinated response. Elements of this response include:

- Review available data to determine if there is an outbreak and its extent.
- Identify population at risk and calculation of age-specific and region-specific attack rates.
- Establish an outbreak control team (OCT) and consider a site visit.
- Identify those requiring chemoprophylaxis and/or immunisation.
- Provide information to all contacts and other persons involved.
- Raise awareness and increase surveillance.
- Provide adequate information to health care providers, affected communities, the media and the general public.
- Monitor and evaluate control measures and prepare final report.

Specific actions implemented should be setting specific. Clusters or outbreaks of meningococcal disease are resource intensive, much more so than management of sporadic cases occurring in the community. Frequently in the initial stages of investigation and control, when comprehensive data may not be available, decisions must be made guided by extrapolation from situations where evidence exists.

8.3 Other useful definitions

Sporadic case – A single case in the absence of previous known close contact with another case.

Primary case (in the context of an outbreak) – A case that occurs in the absence of previous known close contact with another case.

Co-primary case – A close contact who develops disease within 24 hours of onset of illness in a primary case.

Secondary case – A close contact who develops disease more than 24 hours after onset of illness in a primary case where the available microbiological characterisation of the organisms is the same.

Home based outbreak
Two or more co-primary or secondary cases in family members, even if they attend the same educational facility would be assumed to be exposed in the home setting rather than the educational setting.

Institution or organisation based outbreak
Two or more confirmed cases with onset in a four-week interval in a grouping with epidemiological links; or two or more confirmed cases with onset in a four-week interval where the available microbiological characterisation of the organisms is the same in a grouping with epidemiological links. When two or more cases which are possible or probable are reported these should be discussed with HPSC and IMMRL with respect to public health action.

Note: when two or more co-primary or secondary cases occur in family members attending the same school it is presumed that their exposure is at home. Chemoprophylaxis is not indicated for the class(es) in this scenario.

Community outbreak
Four or more confirmed cases with onset in a three-month interval where the available microbiological characterisation of the organisms is the same, and incidence at least 40/100,000 in any age group in a three-month interval.

8.4 Identification of outbreaks
Ongoing surveillance is needed to identify cases and possible clusters and outbreaks. The following changes in the epidemiology of meningococcal disease are suggestive of an outbreak:

- An increased rate of disease. In small populations, it may be more useful to focus on the number of cases rather than the rate.
- Clustering of patients in an age group, setting or a shift in the age distribution of cases.
- Phenotypic and genetic similarity among strains causing disease in the population. For serogroups B and C, the likelihood that two strains are related increases as one goes from serogroup in common to serotype and serosubtype in common, to nucleic acid and enzyme electrophoretic types in common. Investigation of subtype and serosubtype may help in the identification of outbreaks. Consultation with the IMMRL should be undertaken in such situations.

Serosubtyping information is valuable when identifying whether temporal or geographical clusters are related and caused by the same strains. Clinicians and public health physicians confronted with investigating such clusters should consult with the Director of the IMMRL. If an isolate is available, the IMMRL can do serosubtyping on the isolate. If no isolate is available sequencing can be done in specialist reference laboratories (Germany). The turn-around time for such sequencing is typically about 7-10 days. Action may need to be taken based on the available information available.

Suspected outbreaks should be reviewed in order to identify the microbiological features of the cases and any epidemiological links between cases. Microbiological investigation should focus on confirmation of the diagnosis and rapid characterisation of the organism in as much detail as possible. The IMMRL undertakes this work in Ireland, and liaises with international laboratories where appropriate.

The identification of possible epidemiological links should include a search for contacts in common, particularly in childcare, educational institutions or other groupings (social or work).

Cases close in time and place but infected with different serogroups (or serotypes or serosubtypes if known), should be managed as sporadic cases (see Chapter 7).

8.5 Management of outbreaks

Following the identification of an outbreak of cases as defined above, the public health actions that follow include: the rapid establishment of an outbreak control team; making a site visit if appropriate; instituting increased surveillance; communication with all involved parties and the community.

8.5.1 Establish outbreak control team (OCT)

An OCT should be convened. The team should include consultants in public health medicine, microbiology and if locally available, a consultant in infectious disease, a senior medical officer (SMO), paediatrics, an infection control nurse, surveillance scientist, and a HSE communications officer. Additional members may include a general practitioner from the area or others as appropriate. The size of the OCT and frequency of meetings may depend on the nature and extent of the outbreak.

From the start data management is needed and administrative support can assist to keep track of meetings, decisions taken and actions implemented, and communications.

8.5.2 Site visit

A site visit may be useful for both OCT and the community:

- to obtain accurate information on the outbreak and setting
- to assess the local infrastructure and resources for control activities such as chemoprophylaxis or vaccination as needed
- to meet local health care workers to give accurate advice
- if necessary, to hold a public meeting to discuss community concerns and
- to identify key stakeholders who will be involved in local management of the outbreak.

8.5.3 Intensified surveillance

Surveillance should be intensified to identify further cases and to collect relevant data on cases.

The following steps should be considered:

- intensified passive surveillance through communication with laboratories, clinicians and hospitals to emphasise the need for immediate notification by telephone or fax on suspicion of the diagnosis
- collection and rapid analysis of epidemiological data on case patients. (see Chapter 4)
- collection of information for contact tracing
- appropriate microbiology testing and collation of data on all cases (see Chapter 6)
- rapid dissemination of information to those who need to know (other public health, clinical personnel, community involved, general public)
- continue heightened surveillance until incidence rate returns to background rate.

8.5.4 Communication

Communication with the public and health care professions is of utmost importance. One spokesperson should be appointed to be the lead communicator on behalf of the OCT.

The need for a helpline should be determined and established if required.

i. Communication with individuals identified as being at risk due to close contact with cases

Information should routinely be given to people identified as being at risk due to close contact or other identified epidemiological risk factor using already developed materials or modifying materials to suit the setting and situation. Pre-existing templates may be modified to facilitate rapid dissemination of information (see examples in Appendix section).

ii. Communication with health care professionals

The health care professionals (GPs, emergency medicine consultant, other hospital clinicians) in the area should be updated on the situation and asked to refer and report any suspect cases immediately. Communications should highlight the importance of early diagnosis, empirical treatment and prompt notification of suspect cases. Emergency department physicians and other clinicians seeing patients should be advised to collect blood cultures and throat swabs before administration of the first dose of antibiotics if possible. Treatment and referral should never be delayed if specimen collection cannot be rapidly taken. Hospital clinicians are encouraged to take throat swabs as well as blood cultures from persons suspected of having meningococcal disease as prior antibiotic therapy may render blood and CSF cultures sterile.

Advice relating to pre-admission antibiotics is discussed in the section on clinical management.

iii. The community at large

Disseminating information to the community may require use of mass media, websites, community meetings and help lines.

iv. The media

The outbreak control team should agree on a single spokesperson who is experienced in dealing with the media. A senior experienced spokesperson is usually best suited to this role.

8.6 Response related to specific settings

8.6.1 Setting based outbreaks

Populations at risk in closed settings such as schools and crèches/preschool facilities are usually relatively easily defined. However, identification of populations at risk in other larger settings (e.g. universities) with less defined networks and close contacts may be more difficult.

When two or more cases are reported from an educational setting, public health should undertake a careful and rapid assessment of the apparent cluster. The review should include the following;

- The clinical features of the cases
- Microbiological data (serogroup and subtype)
- Dates of illness onset and dates of last attendance at the site
- Epidemiological links between cases (age, class or school year, home address, social activities, friends)
- Numbers of students in the school and in each school year
- The public health management options include
    - Giving information out to students/staff/parents only
    - Giving out information and offering wider prophylaxis in the school or education setting.

If following investigation it is considered that the cases do not meet the case definition for meningococcal disease, further action may not be indicated.

8.6.2 Public health action

Chemoprophylaxis

In responding to setting specific outbreaks, chemoprophylaxis is considered for a wider group than solely close contacts even though the evidence to support the use of chemoprophylaxis to prevent further cases is not strong. The target group should be a discrete group that contains the cases and makes sense to staff/parents/students. Once a specific group is identified prompt action is recommended.

Close contacts should be provided with chemoprophylaxis as for sporadic cases (see Section 7.2 on chemoprophylaxis following exposure).

Co-primary or secondary cases who are identified as being close contacts of the index case are assumed (unless microbiological evidence is to the contrary) to have acquired their disease as a result of this close household-like contact. Such cases are not counted when deciding whether to offer setting based chemoprophylaxis (other than in childcare settings). For example, two probable cases in university students in the same class who share accommodation are assumed to been exposed in a household-like setting of the shared accommodation rather than in class.[3]

Antibiotic doses are defined elsewhere and are the same as those used for chemoprophylaxis for close contact with sporadic cases. When mass chemoprophylaxis is given in institutions, it should be given whenever possible on the same day with written parental, caregiver or patient consent. Adequate information should be provided on the possible adverse effects of the agent selected. Individuals given antibiotics should be advised to contact their GP in the event of suspected adverse events occurring.

Vaccination for specific setting-based outbreaks
Local outbreaks of serogroup C or serogroup B disease
Immunisation has been shown to be effective in controlling outbreaks in institutions (e.g. schools) and communities, reducing the incidence of infection.

Currently most cases of meningococcal disease in Ireland are meningococcal group B. Immunisation with MenB vaccine may be considered to control clusters or outbreaks of meningococcal B disease. A monovalent conjugate meningococcal C vaccine is available in the event of an outbreak related to serogroup C.[35, 63]

In the event of a cluster of cases associated with types A, Y or W_{135} the quadrivalent conjugate vaccine $ACYW_{135}$ should be offered to all close contacts over 2 months of age.

As for any immunisation, informed consent should be obtained prior to vaccination.[64] Adequate information about the risks and benefits should be given to the individual or the parent or guardian prior to consent being obtained. Information leaflets relating to each vaccine is readily available.

An adolescent 16 years of age or older, if able to understand the benefits and risks of the proposed vaccination, can give or refuse consent independently of a parent or guardian.[64]

8.7 Community outbreaks

These outbreaks are difficult to define and manage and have to be distinguished from a general increase in incidence caused by more than one serogroup. Table 8.1 lists public health actions for a community outbreak.

A community outbreak is defined as:
The occurrence of four or more confirmed cases of invasive meningococcal disease due to a single serogroup (and serotype and serosubtype if characterisation to this level is available) in a three-month period; and there is an incidence of this type of at least 40 per 100,000 in a specific age group in the same three month period.

The affected age groups should be clearly defined. Vaccination should be offered if the incidence in the affected age group(s) is high.

8.7.1 Chemoprophylaxis (See Section 7.2 on chemoprophylaxis)
Community wide chemoprophylaxis is not routinely recommended as widespread use of chemoprophylaxis in community outbreaks has not been shown to be of value and may result in:

- the eradication of benign strains of *Neisseria meningitidis* that provide protective antibodies
- the generation of drug resistant strains and
- an increase in the prevalence of drug-related adverse events.

8.7.2 Vaccination for community outbreaks
In the event of a cluster of *N. meningitidis* serogroup B or C disease, MenC vaccine should be used for unvaccinated individuals in the community. MenB vaccine may be considered. The target group should be determined based on age group most at risk. Individuals who are vaccinated but have not received a dose in the past year should be given a booster dose.[35] For outbreaks associated with A, W_{135} or Y the conjugate or polysaccharide vaccine may be considered and depends on age of contacts.[63]

Table 8.1. Summary of recommended public health actions for community based outbreak

Setting	Clustering of cases	Information	Chemoprophylaxis	Vaccination
Community based outbreak	Four or more confirmed cases of $ACW_{135}Y$ in three months and incidence 40/100,000 total community population in three months	Mass media	Limit to close contacts of cases	If group C, consider booster for those already vaccinated if they have not received a dose in the last year and one dose for non-vaccinated- groups targeted may depend on ASIR*. For B, $AW_{135}Y$ may need to consider for those in same age group.

**ASIR: Age Specific Incidence Rate*

8.8. Documentation and review

Departments of public health should liaise with both HPSC and the IMMRL in relation to the investigation and control of clusters of meningococcal disease. A final report relating to the management of each outbreak should be made and forwarded to all partners to provide an opportunity to review management and actions undertaken during the course of the outbreak.

CHAPTER 9.
CHEMOPROPHYLAXIS FOR CONTACTS OF MENINGOCOCCAL DISEASE

Key points

- **There is evidence on the microbiological clearance of meningococci following the administration of appropriate antibiotics**
- **The decision to provide chemoprophylaxis is based on a risk assessment following the notification of each case**
- **There are three antibiotics (rifampicin, ciprofloxacin, ceftriaxone) currently used in Ireland for chemoprophylaxis of meningococcal disease**
- **For individuals already on medications (for chronic diseases or hormonal contraceptives) the SPCs of these medications should be reviewed to determine the most suitable chemoprophylactic agent for the individual**

The recent ECDC guidance found the following[2]:

- High evidence that rifampicin and ciprofloxacin eradicate carriage (>1 RCT, meta-analyses), and effectiveness values are very consistent across studies.
- Moderate evidence suggests that ceftriaxone eradicate carriage (one RCT and open studies).
- Moderate evidence suggests that there is no regimen (type of antibiotic, dosage, duration, and route) superior to others in terms of effectiveness or rate of side effects.
- Moderate evidence suggests that side effects following prophylaxis are mild and transient.
- Moderate evidence that ciprofloxacin is associated with a low rate of osteoarticular side effects in children no higher than as has been seen with other prophylactic drugs.

There are three antibiotics currently used in Ireland for chemoprophylaxis of meningococcal disease; each agent has advantages and disadvantages. See Table 9.1 for details on chemoprophylactic agent recommended in various settings.

9.1 Rifampicin

Rifampicin can be used in all age groups and for the majority of the population (except for those with contra-indications). For pregnant women and women on systemic hormonal contraceptives it is an alternative option. The latter include the oral contraceptive pill (OCP), contraceptive patches and implants.

Rifampicin is contraindicated in the presence of jaundice or known hypersensitivity to rifampicin. It is also contraindicated when given concurrently with the combination of saquinavir/ritonavir (antiretroviral drugs).

Rifampicin is a potent inducer of certain cytochrome P-450 enzymes. Co-administration of rifampicin with other drugs that are also metabolised through these cytochrome P-450 enzymes may accelerate the metabolism and reduce the activity of these other drugs. Therefore, caution should be used when prescribing rifampicin with drugs metabolised by cytochrome P-450. These drugs include anticoagulants, anticonvulsants, and hormonal contraceptives. For increased details, please refer to most recent summary of product characteristics (SPC) available at www.hpra.ie or www.medicines.ie.

Women taking an oral contraceptive should continue to take the OCP, omitting any pill free interval while taking rifampicin and for the seven days after the last dose of rifampicin. The users of the OCP and of other hormonal contraceptives should use additional barrier contraception while taking rifampicin and for four weeks after the last dose of rifampicin.

Information on side effects, including staining of urine and contact lenses should be supplied when giving Rifampicin.

The recommended schedule for rifampicin for chemoprophylaxis for meningococcal disease is detailed below:

Dose of Rifampicin:
Children 0-12 months: - 5 mg/Kg twice daily for two days
Children, 1-12 years: - 10 mg/Kg twice daily for two days (max 600 mg)
Children over 12 years and adults: 600 mg twice daily for two days.

The average doses of rifampicin are as follows[3]:

Age	Dose twice daily for two days
Suitable doses in children based on average weight for age are:	
0-2 months	20 mg (1 ml*)
3-11 months	40 mg (2 ml*)
1-2 years	100 mg (5 ml*)
3-4 years	150 mg (7.5 ml*)
5-6 years	200 mg (10 ml*)
7-12 years	300 mg (as capsule/or syrup)

** Rifampicin syrup contains 100 mg/5 ml*

Note: for paediatric doses- a small syringe should be provided for ease of administration

9.2 Ciprofloxacin

Ciprofloxacin can be used in all age groups and for the majority of the population (except for those with contra-indications). It is the antibiotic of choice for those on the oral contraceptive pill. It may be particularly useful when there is a setting with a large number of adult contacts (e.g. university students). In this scenario an assessment of the logistics will guide the antibiotic choice. Also an assessment of individual characteristics may suggest the use of ciprofloxacin e.g. those who are taking an oral contraceptive or are utilising contact lenses.

Ciprofloxacin has a number of advantages over rifampicin. It is given as a single dose. It does not interact with systemic hormonal contraceptives. It is more readily available in community pharmacies and does not affect contact lenses.

Ciprofloxacin is contraindicated for those with hypersensitivity to the active substance, to other quinolones or to any of the excipients (please refer to most recent summary of product characteristics (SPC) available at www.hpra.ie or www.medicines.ie). It is also contraindicated for concomitant administration with tizanidine (muscle relaxant e.g. zanaflex). Ciprofloxacin should be used with caution in patients with a history of epilepsy or conditions which predispose to seizures. Increased plasma levels of theophylline can occur following concurrent administration (please see relevant current SPC for more detail).

Ciprofloxacin is usually not recommended in children due to induced arthropathy in juvenile animals but the ECDC report detailed "abundant evidence of lack of joint damage was found in young children given ciprofloxacin."[2]
A single dose is extremely unlikely to have a significant effect.

Ciprofloxacin suspension is currently provided on an unlicensed basis in Ireland - other versions of ciprofloxacin are licensed.

Anaphylactic reactions, although very uncommon, have been reported in about one or less than one in one thousand people following single-dose ciprofloxacin.[65,66] A recent Irish report found an anaphylactic rate of 0.3 in 1,000 people and a general allergic reaction rate of 2.2 in 1,000. In this incident of the 3,605 individuals who received ciprofloxacin there were seven mild allergic reactions (rashes), one moderate non-specific reaction and one anaphylactic reaction.[67]

The recommended doses of **ciprofloxacin** for chemoprophylaxis are:

For adults :	A single oral dose of 500mg
For children aged 12 years or more	A single oral dose of 500mg
For children aged 5-12 years	A single oral dose of 250mg
For children under 5 years	A single oral dose of 30mg/Kg up to a max of 125mg

Although ciprofloxacin is not licensed for chemoprophylaxis of meningococcal disease in Ireland, it is recommended by the Bacterial and Viral Meningitis/Encephalitis Sub-committee of the Scientific Advisory Committee (Irish National Working Group) for that purpose.

9.3 Ceftriaxone

Ceftriaxone can only be given by injection and intramuscular injection can be painful. Potential side effects include diarrhoea, allergies, hepatic and blood disorders. Please refer to most recent summary of product characteristics (SPC) available at www.hpra.ie or www.medicines.ie.

The recommended doses of **ceftriaxone** for chemoprophylaxis are:

For adults:	a single dose of 250mg IM
For children 12 years of age and older:	a single dose of 250mg IM
For children younger than 12 years of age:	a single dose of 125mg IM

Ceftriaxone should not be used for chemoprophylaxis in infants in the first 4 weeks of life.

Although ceftriaxone is not licensed for chemoprophylaxis of meningococcal disease in Ireland, it is recommended by the Bacterial and Viral Meningitis/Encephalitis Sub-committee of the Scientific Advisory Committee (Irish National Working Group) for that purpose.

9.4 Pregnant and lactating women

The ECDC guidance states that the safety of antibiotic regimens for chemoprophylaxis in pregnant and lactating women is poorly described. The only RCT involving 176 pregnant and lactating women administered ceftriaxone (2g) via the intramuscular route and only five subjects reported mild side effects. However, there was no control group.[68]

Rifampicin teratogenicity has been demonstrated in high doses in animals but epidemiological studies did not reveal any notable risk in humans when administered for tuberculosis treatment.[69] **When administered during the last few weeks of pregnancy, rifampicin can cause post-natal haemorrhages in the mother and infant**, for which treatment with Vitamin K1 may be indicated for both mother and neonate. In the newborn, careful surveillance for bleeding symptoms and decrease of coagulation factors is recommended. The SPC for ciprofloxacin carries a precaution on its use in pregnancy – "As a precautionary measure, it is preferable to avoid the use of ciprofloxacin during pregnancy". However, short duration treatment for other indications appeared to be safe.[70, 71] It is recommended for use in pregnancy and lactation by Public Health England.

Summary
Choice of prophylactic antibiotic

Rifampicin and Ciprofloxacin are both recommended for chemoprophylaxis except for the following:

- **Women taking hormonal contraceptives – ciprofloxacin is the preferred option as rifampicin can affect the efficacy of these contraceptives.**
- **For pregnant women Ciprofloxacin is the preferred option**
- **For those who have contraindications to the use of one of these antibiotics, e.g. allergy or potential drug interaction, please review options.**

Table 9.1 Summary of chemoprophylactic agents recommended for chemoprophylaxis and alternatives

Population	Antibiotic for chemoprophylaxis		
	Rifampicin	Ceftriaxone	Ciprofloxacin
Children	Recommended	Not routine option (intramuscular injection)	Recommended
Adults	Recommended	Not routine option (intramuscular injection)	Recommended
Female adults on hormonal contraceptives (e.g. OCP, patches, implants)	Alternative option- advise contraceptive precautions	Not routine option (intramuscular injection)	Recommended option
Pregnancy	Alternative option	Alternative option	Recommended
Lactation	Recommended	Alternative option	Recommended
Large institution*	Recommended	Not routine option (intramuscular injection)	Recommended

*These scenarios require assessment of logistic issues and of individual characteristics e.g. OCP, contact lenses.

9.5 Reporting of adverse events following administration of any drug

In the unlikely event of an adverse event occurring following administration of a medicine, all reports should be made to the Health Products Regulatory Authority at www.hpra.ie.

The full website link is located at:
https://www.hpra.ie/homepage/about-us/report-an-issue/human-adverse-reaction-form

CHAPTER 10.
INFECTION CONTROL FOR MENINGOCOCCAL DISEASE

Key points

- ***N. meningitidis*** **is transmitted person-to-person by aerosols, droplets or direct contact with respiratory secretions from a person carrying the organism.**
- **Suspect/confirmed cases should be placed in a separate room for the first 24 hours following initiation of treatment.**
- **After 24 hours of appropriate antibiotic treatment individuals with meningococcal disease are considered to be no longer infectious.**
- **HCWs should wear appropriate masks (surgical or shield as appropriate) when in close contact with an infectious patient for the first 24 hours after initiation of treatment.**
- **Pre-exposure vaccination may be considered for HCWs at increased risk of exposure (e.g. laboratory workers handling specimens).**
- **Infection control team should be notified when patient is admitted.**

10.1 Introduction

N. meningitidis is a human-only pathogen which colonizes mucosal surfaces, typically the nasopharynx. It is transmitted from person-to person by aerosols, droplets or direct contact with respiratory secretions from a person carrying the organism. Person-to-person transmission can occur through coughing, kissing, and sneezing. The organism is not spread by casual contact. Generally, it is considered that meningococci do not survive outside the host.[73]

For the individual who acquires a meningococcus, the outcome is usually asymptomatic nasopharyngeal carriage, with invasive meningococcal disease an uncommon result.[74] To cause disease a virulent organism must overcome the local defence mechanisms and become invasive.

Once appropriate antibiotic treatment has commenced the viability and infectivity of the meningococcus decreases rapidly. After 24 hours of appropriate antibiotic treatment, individuals with meningococcal disease are considered to be no longer infectious. Therefore, additional precautions (droplet transmission) should be applied for 24 hours after the initiation of specific therapy and thereafter standard infection control measures apply.

10.2 Health care workers (clinical)

Health care workers (HCWs) are not considered to be at particularly increased risk of disease unless directly exposed to large particle droplets/secretions from the respiratory tract of a case within the period of infectivity. HCWs are advised to wear surgical face masks (Table 10.1) when carrying out high risk procedures and when within one metre of a patient. High risk procedures are those which may result in generation of respiratory droplets (such as may occur during intubation, naso-pharyngeal or tracheal suctioning) within 24 hours of commencement of appropriate systemic antibiotics.

Chemoprophylaxis is recommended only for those HCWs whose mouth and nose is directly exposed to respiratory droplets or secretions of a probable or confirmed case of meningococcal disease within 24 hours of the commencement of antibiotics. Chemoprophylaxis is not recommended without a clear history of such exposure.

Table 10.1 Infection control precautions recommended for meningococcal cases in clinical settings

Requirement	Additional precautions for the first 24 hours of appropriate systemic antibiotic treatment
Gloves	Standard precautions
Impermeable apron/gown	Standard precautions
Mask	Surgical mask[a]
Goggles/face-shield	Protect face if splash likely†
Patient in single room	Yes - door closed
Negative pressure	Not required
Transport of patients	Surgical mask[a] for patient Notify area receiving patient
Other	If single room unavailable provide a minimum one metre of separation between patients in ward accommodation
Infection control team informed	Standard precautions

[a]*Surgical mask refers to a fluid-repellent, paper filter mask used in surgical procedures.*
†Wear a mask (shield type) when carrying out close examination on a patient (e.g. when performing ophthalmic fundoscopy) especially if they have coughing, sneezing, or if undertaking aerosol generating procedure (including examination of throat).

10.3 Visitors of case

Visitors within 1 metre of the case in the first 24 hours of antibiotic treatment should wear a surgical mask (precautions for droplet transmission). Thereafter, standard infection control measures apply. Visitors do not need to wear protective clothing unless they are at risk of exposure to naso-pharyngeal secretions but should be instructed to decontaminate their hands before and after visiting cases.

10.4 Pathologists and anatomical pathology technicians

Pathologists and pathology technicians who may be exposed to infected airborne droplets during the performance of an autopsy should receive chemoprophylaxis when a mask has not been worn and when the deceased individual did not receive appropriate systemic antibiotics for a minimum of 24 hours prior to death.

10.5 Relatives contact with body of deceased

It is not necessary to restrict relatives viewing, touching, and kissing the body on infection control grounds. However, chemoprophylaxis and vaccination may be required if these individuals were close contacts of the deceased prior to death (see Section 7.2 on chemoprophylaxis).

10.6 Handling and transport of deceased patients

All bodies of deceased patients should be handled using standard precautions. Body bags are not necessary and transport to other countries for burial or cremation does not pose a risk. There is no restriction on embalming.

10.7 Pre-exposure vaccination

Staff handling or conducting research on *N. meningitidis* or staff working in higher risk settings such as the IMMRL or paediatric or infectious disease units where admissions related to meningococcal disease are frequent, may have a higher level of exposure that would justify vaccination.

The need for, and timing of, a booster dose of a quadrivalent vaccine has not yet been determined.

CHAPTER 11.
PUBLIC HEALTH MANAGEMENT OF CASES OF *H. INFLUENZAE* TYPE B (HIB) DISEASE

Key points

- Chemoprophylaxis is recommended for household contacts only if there is an at-risk child or adult in the household.
- Chemoprophylaxis is not recommended for preschool contacts of a single case.
- Chemoprophylaxis is recommended for preschool contacts if two or more cases occur within two months.
- Non-immunised contacts <10 years should be offered vaccine.
- Incompletely immunised contacts under four years should complete their schedule.

11.1 Transmission of Hib

The primary mode of Hib transmission is presumably by respiratory droplet spread, although firm evidence for this mechanism is lacking. Humans (asymptomatic carriers) are the only known reservoir. Hib does not survive in the environment on inanimate surfaces. The contagious potential of invasive Hib disease is considered to be limited.[75]

Chapter 4 of the Immunisation Guidelines for Ireland, 2008 contains recommendations for immunisation and chemoprophylaxis of cases and contacts of invasive Hib disease.[63]

11.2 Chemoprophylaxis of contacts of cases of invasive Hib disease

1. Household contacts (except pregnant women):

Household contacts are regarded as those who share living or sleeping accommodation with the case.

Chemoprophylaxis is indicated for all household contacts irrespective of age or immunisation history in the following situations:

- if there are any children <4 years of age who are unvaccinated or incompletely vaccinated (e.g. have not had Hib booster dose)
- if there are any unvaccinated children <10 years of age
- if there are any persons at increased risk of invasive Hib disease (asplenia, hyposplenism, etc.) irrespective of their age or immunisation status.

2. Play-group, crèche or primary school contacts aged <10 years:-

Chemoprophylaxis is not indicated for contacts of single sporadic case. However, immunisation may be recommended, see below for details.

When two or more cases occur within two months, chemoprophylaxis should be offered to all room contacts, both adults and children.

11.3 Chemoprophylaxis for cases of invasive Hib disease

The index case should be given chemoprophylaxis prior to discharge if not treated with cefotaxime or ceftriaxone. These drugs eradicate Hib from the nasopharynx.

11.4 Immunisation of contacts of invasive Hib disease

1. Household contacts

- Non-immunised contacts aged under 10 years should be given Hib vaccine. Those aged 1-9 years require only one dose.
- Incompletely immunised contacts aged under four years should complete their schedule.

2. Play-group, crèche or primary school contacts aged <10 years
In the case of a single sporadic case immunisation is recommended as follows:-

- Non-immunised room contacts <10 years should be offered Hib vaccine.
- Incompletely immunised contacts under four years should complete schedule.

When two or more cases occur within two months, in addition to immunisation, chemoprophylaxis should be offered to all room contacts, both adults and children.

3. Index case
The index case, if younger than two years of age, may have low levels of anticapsular antibodies and could get a second episode of disease. Therefore, immunisation should be given according to the current recommended schedule irrespective of vaccine history, starting one month after onset of disease or as soon as possible thereafter.

Immunised children who develop invasive Hib disease have an increased incidence of IgG2 deficiency and should be considered for immunological evaluation.

11.5 Recommended chemoprophylaxis

Rifampicin is the recommended drug.

Rifampicin dose for prophylaxis:

- Infants under one year of age – 10 mg/kg once daily for four days
- Children and adults– 20 mg/kg once daily for four days, max. 600 mg/day.

Chemoprophylaxis is not recommended for pregnant women who are contacts of cases because rifampicin is not licensed for this indication.

CHAPTER 12.
PUBLIC HEALTH MANAGEMENT OF CLUSTERS OF SERIOUS PNEUMOCOCCAL DISEASE

Key points

- Invasive pneumococcal disease (IPD) is a notifiable disease. Enhanced surveillance of IPD paediatric cases is routinely undertaken.
- Individual cases IPD occurring in closed setting do not require public health control measures. Chemoprophylaxis is not recommended for close contacts of individual cases of IPD.
- Rarely *S. pneumoniae* can cause clusters of serious disease. Clusters have been described in settings such as hospitals, long term care facilities, prisons, military settings, hostels, child day care centres.
- Clusters of invasive pneumococcal disease (two or more cases in a closed setting in 14 days) should be reported to the local department of public health immediately for further investigation.
- Control measures that may be required include: infection control measures, antibiotic chemoprophylaxis, vaccination of close contacts.

12.1 Introduction

There is a limited evidence base for the management of clusters of severe pneumococcal disease. The following guidance data relating to clusters of severe pneumococcal disease has been based on the HPA document "Interim UK guidelines for the public health management of clusters of serious pneumococcal disease in closed settings" (July 2008).[4]

12.2 Definitions

A suspect cluster is defined as the occurrence of two or more cases of serious pneumococcal infection occurring in a closed setting within a 14 day period (based on clinical, microbiological, epidemiological findings).

A confirmed cluster is defined as two or more confirmed cases (meeting case definition) of the same (or not yet determined) serotype in a closed setting with onsets within a two week period.

A closed setting is defined as a setting where the individuals are normally in close contact with each other and include the following settings: household, residential home, hospital ward, military establishment, prison, homeless shelter, children's day care centre and other similar settings.

Close contact is defined as an individual who has had significant contact with a cluster case in the closed setting. The period of significant contact is from 48 hours before onset of symptoms in the case until completion of 24 hours of systemic antibiotic treatment.

Significant contact may be either prolonged or transient. Prolonged contact is defined as either overnight or daytime stay in the same closed setting.

Transient close contact is defined as when the mouth or nose is directly in contact with the large droplets or secretions from the respiratory tract of a cluster case during the acute illness.

12.3 Investigation

The following information should be collected when investigating suspect or confirmed clusters:

- Core and enhanced notification data (see enhanced form) including
    - Risk factors
    - Vaccination detail
    - Complications
    - Microbiological data
    - Cluster investigation information including (see Appendix 3)
    - Setting and population at risk
        - Type of setting (children's day-care centre, school, residential, ward etc.)
        - Number of persons in setting with basic epidemiological description (age, employment, vaccination status, duration in setting)
        - Identification of any highly exposed sub-group e.g. school class
        - Close contacts.

Preliminary investigation is required to determine if immediate public health action or further investigation is required.

Suspect cluster

All suspect clusters should be investigated to confirm or refute the diagnosis.

Confirmed cluster

A confirmed cluster requires immediate public health action.

12.4 Laboratory investigation of cases (and clusters)

Pneumococcal disease should be confirmed and serotype information sought as soon as possible. Early liaison between the consultant microbiologist, the Department of Public Health, HPSC and National Pneumococcal Typing Project is recommended.

Additional tests may guide case management or cluster investigation

The following tests are not confirmatory of invasive pneumococcal disease but can support the investigation and management of suspect cases:

- Sputum - culture
- Nasopharyngeal swabs – culture.

Non culture diagnostic tests

- Urinary antigen tests.

Urinary antigen tests have been used to assist in the clinical diagnosis of invasive pneumococcal disease. However, the clinical utility of the test is reduced in younger children as the positive predictive value is lower. A positive test may reflect carriage rather than disease. Therefore, a case with *S. pneumoniae* antigen detected in urine but with no positive culture is considered to meet the criteria for 'possible' rather than 'confirmed' cases (see case definitions).

Positive results, particularly in children < 2 years of age, must be interpreted with caution and in the context of clinical observations and other investigations.

PCR

PCR- based assays for the detection of specific DNA sequences of *S. pneumoniae* are available and can be used on CSF, blood and fluids from normally sterile sites. Positive results in children < 2 years of age must be interpreted with caution and in the context of clinical observations and other investigations.

Serotyping

Rapid ascertainment of serotype is an important tool to confirm or exclude a suspected cluster, to assess the relatedness of cases within a cluster and thus inform public health management.

Serotyping is undertaken by the National Pneumococcal Typing Project at the Department of Clinical Microbiology, RCSI Education and Research Centre, Beaumont Hospital, Dublin.

All pneumococcal isolates should be sent to the National Pneumococcal Typing Project as soon as possible, particularly when investigating clusters of serious IPD. Upon suspicion of a cluster the microbiologist should liaise directly with the laboratory.

12.5. Public health management

When a cluster has been confirmed public health interventions are recommended for close contacts (definition above).

The following action is recommended:

- Information provision (see appendix for examples of information leaflet)
- Implementation of infection control measures (isolation, cohorting, hand and respiratory hygiene)
- Offering antibiotic chemoprophylaxis (seek microbiological advice)
- Vaccination, if appropriate.

Public health management should be implemented as soon as possible and should not be delayed pending the results of serotyping.

12.6 Specific interventions – by setting

12.6.1 Non-residential settings

Closure of schools or other non-residential settings is not recommended. Contacts do not need to be excluded.

12.6.2 Residential settings

Consideration should be given to closure to new admissions in consultation with infection control.

12.7 Infection control

Advice should be sought from the infection control team.
Guidance for infection control is similar to that for meningococcal disease (Chapter 9).

12.8 Antimicrobial prophylaxis

The aim of antibiotic prophylaxis is to reduce carriage of the outbreak serotype among the close contacts and interrupt transmission. It may also provide individual protection against serious disease among close contacts that may be in the incubation phase.

12.8.1 Indications

Antibiotics should be offered to close contacts who have had significant contact from 48 hours before to 24 hours after completion of 24 hours of systematic antibiotic treatment (as defined earlier).

In the closed setting close contacts may be readily identified. If however, close contacts cannot be identified consideration should be given to chemoprophylaxis for all contacts in the closed setting.

Chemoprophylaxis is not routinely recommended for health care workers unless fitting the close contact definition.

Antibiotic prophylaxis should be given as soon as possible (ideally within 24 hours) regardless of vaccination status. It may be offered up to 14 days after the onset of illness in the last case of the cluster.

12.8.2 Choice of antibiotics

The choice of antibiotic should be guided by the in vitro susceptibility of the bacteria and the target population. Consultation with the microbiologist is advised before commencing prophylaxis.

No antibiotics are currently licensed for chemoprophylaxis of *S. pneumoniae*. However, if susceptible, amoxicillin (7 day course) has been used as first line and azithromycin (three day course) or rifampicin (four days) have been used where resistance to amoxicillin has been reported. (Consultation with microbiologist is needed prior to antibiotic prophylaxis administration).

12.9 Vaccination

All children and adults falling into a group at higher risk of pneumococcal disease, including those 65 years of age and older are recommended PPV 23 by the National Immunisation Advisory Committee (NIAC).

In the management of a cluster PPV or PCV will not provide protection in the first 10-14 days following vaccination. Simultaneous prophylaxis is thus required to clear carriage for this intervening period.

The algorithm outlines the recommendations for vaccination following identification of a cluster. The choice of vaccine will depend on the serotype identified in the cluster. If the cluster is caused by a PCV serotype PCV is recommended if the cluster is caused by a PPV23 non-PCV serotype then PPV23 is recommended.

All individuals (cases and contacts) should be vaccinated with the appropriate pneumococcal vaccine according to their age and risk status.

Note: Children < 2 years of age are not recommended PPV23. Polysaccharide vaccines administered at this age result in hypo-responsiveness to subsequent doses.

12.10 Swabbing of close contacts

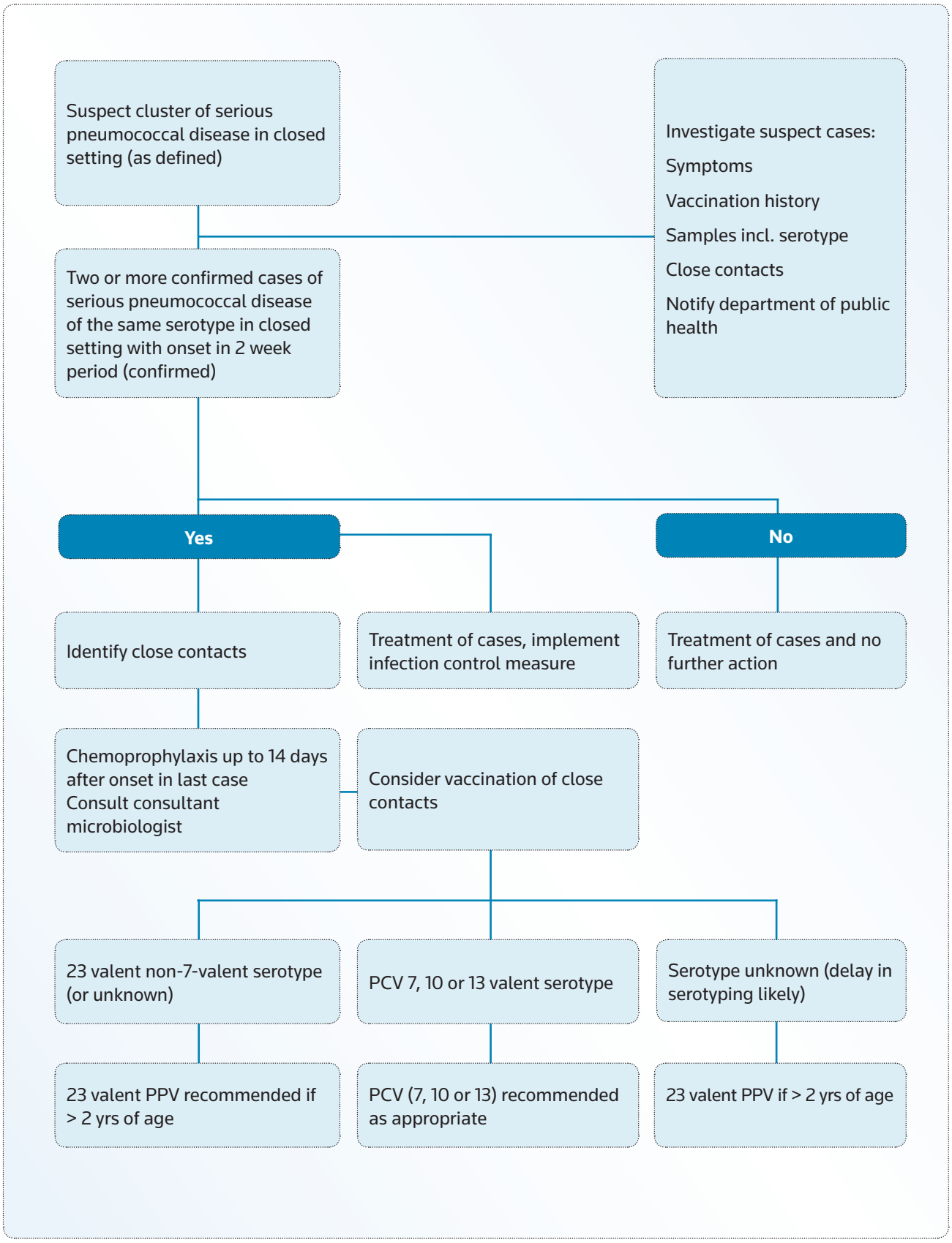
Swabbing of close contacts may be considered as part of the investigation. Prior to initiating this activity the investigators should seek advice from the local consultant microbiologist, HPSC and the serotyping project group. Chemoprophylaxis should not be delayed while awaiting results.

12.11 Surveillance and communication

All clusters of pneumococcal disease (suspect or confirmed) are notifiable. Suspicion of confirmed clusters should be reported to the department of public health.

Following the identification of a cluster of pneumococcal disease an outbreak control team (OCT) should be convened and include the SMO, SPHM, microbiologist, infection control, surveillance scientist and communications officer.

Figure 12.1. Flow chart – investigation of cluster of IPD



Modification of HPA flowchart from document – Interim guidelines for the public health management of clusters of serious pneumococcal disease in closed settings (July 2008)[4]

APPENDIX 1.

Annual Number of Bacterial Meningitis Notifications by Causative Pathogen, 1999-2010

Pathogen	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
*Neisseria meningitidis**	536	515	330	253	237	198	203	209	179	168	147	114	**3089**
Pathogen – Unknown	15	31	33	20	27	28	21	36	22	17	25	22	**297**
Streptococcus pneumoniae	19	25	20	15	25	22	19	24	35	32	28	20	**284**
Mycobacterium tuberculosis‡	7	6	2	6	8	6	9	7	6	6	8	n/a	**71**
Haemophilus influenzae†	2	6	2	3	7	4	9	4	2	3	3	2	**47**
Streptococcus agalactiae (GBS)	4	3	3	2	2	6	5	4	9	6	7	9	**60**
Escherichia coli	4	2	3	0	4	1	0	3	0	11	3	2	**33**
Listeria sp.	0	1	2	0	2	1	1	1	3	3	1	3	**18**
Staphylococcus aureus	0	1	0	1	0	0	1	1	0	3	2	6	**15**
Leptospira sp.	0	0	0	0	0	1	0	1	1	1	1	0	**5**
Streptococcus pyogenes	0	0	0	0	0	0	1	0	0	2	0	1	**4**
Pseudomonas aeruginosa	0	0	0	0	0	1	1	0	0	0	0	0	**2**
Salmonella sp.	0	0	0	0	1	0	0	0	0	0	1	0	**2**
Enterococcus faecalis	0	0	0	0	0	0	0	0	0	1	1	0	**2**
Staphylococcus capitis	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Citrobacter koseri	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Coagulase negative staphylococcus	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Enterobacter sp.	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Gamella sp.	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Group C streptococcus	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Klebsiella pneumoniae	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Mycoplasma pneumoniae	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Proteus mirabilis	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Streptococcus bovis	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Streptococcus Group D	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Streptococcus sp.	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Serratia liquefaciens	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Sphingomonas paucimobilis	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Total	**587**	**590**	**396**	**300**	**314**	**268**	**271**	**292**	**259**	**255**	**229**	**182**	**3943**

* includes meningococcal septicaemia cases also

† 1999-2003, based on data from the bacterial meningitis database; 2004 – date, based on data from CIDR

‡ based on data from National TB Surveillance System (NTBSS), figures for 2009 are provisional, data for 2010 not yet available

APPENDIX 2.

Useful Resources

Resource	Web link
Irish	
Health Protection Surveillance Centre	www.hpsc.ie
Health Products Regulatory Authority	www.hpra.ie
National Immunisation Office	www.immunisation.ie
National Immunisation Advisory Committee	www.rcpi.ie/policy-and-advocacy/national-immunisation-advisory-committee
Irish Society of Clinical Microbiologists	www.iscm.ie
Meningitis Research Foundation (Ireland)	www.meningitis.org
European	
European Centre for Disease Prevention and Control	http://ecdc.europa.eu
Public Health England (PHE)	www.gov.uk/government/organisations/public-health-england
Meningitis Research Foundation	www.meningitis.org/
Other	
World Health Organization	www.who.int
Centers for Disease Control and Prevention (US)	www.cdc.gov

APPENDIX 3.
ENHANCED SURVEILLANCE FORMS

Please note: to view the most recent enhanced surveillance forms go to: **www.hpsc.ie**
Surveillance forms for specific diseases can be found under the specific disease sections

Invasive meningococcal disease (Sample)

Version 2.4 22/03/2011

INVASIVE MENINGOCOCCAL DISEASE / BACTERIAL MENINGITIS (NOS) NOTIFICATION FORM

Patient Details:

HSE Area | LHO | Hospital | Hospital Chart No. | Date of Onset | Date of Admission | Date of Notification

Patient Name or Initials | Date of Birth | Age | Sex | Address | County

Please tick if attending:

Creche ☐ Primary School ☐ Secondary School ☐ 3rd Level ☐ Other ☐ Not applicable ☐

Outcome:

Died ☐ Long-term sequelae ☐ Recovering ☐ Recovered ☐ Still ill ☐

Cause of death:

Due to this ID ☐ Not due to this ID ☐ Not known ☐ **Date of Death:**

Contact with previous case:

Yes ☐ No ☐ If Yes, please specify contact and time period

Clinical Criteria:

Fever ☐ Meningeal signs ☐ Petechial rash ☐ Septic shock ☐ Septic arthritis ☐

Laboratory Investigations:

	POS	NEG	Not Done
Blood Culture			
CSF Culture			
Other sterile site, culture			
If other, please specify			
Blood PCR			
CSF PCR			
Other sterile site, PCR			
If other, please specify			
Skin Lesion Culture			
CSF Microscopy (intracellular GNDC)			
Skin Lesion Microscopy (intracellular GNDC)			
Throat Culture			
Nose Culture			
Eye Culture			

Imported case: (i.e. infection acquired abroad or developed within 2 days of arrival in ROI)

Yes ☐ No ☐ If Yes, specify country

Final Diagnosis:

Organism

Serogroup Serotype

Case classification

Confirmed ☐ Probable ☐ Possible ☐

Date of Diagnosis

Vaccination history (relating to serogroup of organism reported):

	Yes	No
Meningococcal C Conjugate		
Meningococcal C Polysaccharide		
Meningococcal ACW135Y Conjugate		
Meningococcal ACW135Y Polysaccharide		
Other vaccine		

If other, please specify

Meningococcal C Conjugate status:

Vaccinated ☐ Incompletely vaccinated ☐

Unvaccinated ☐ Not known ☐

Meningococcal C Conjugate vaccination details:

	Date	Brand
1st Dose		
2nd Dose		
3rd Dose		

1st Dose Batch No.

2nd Dose Batch No.

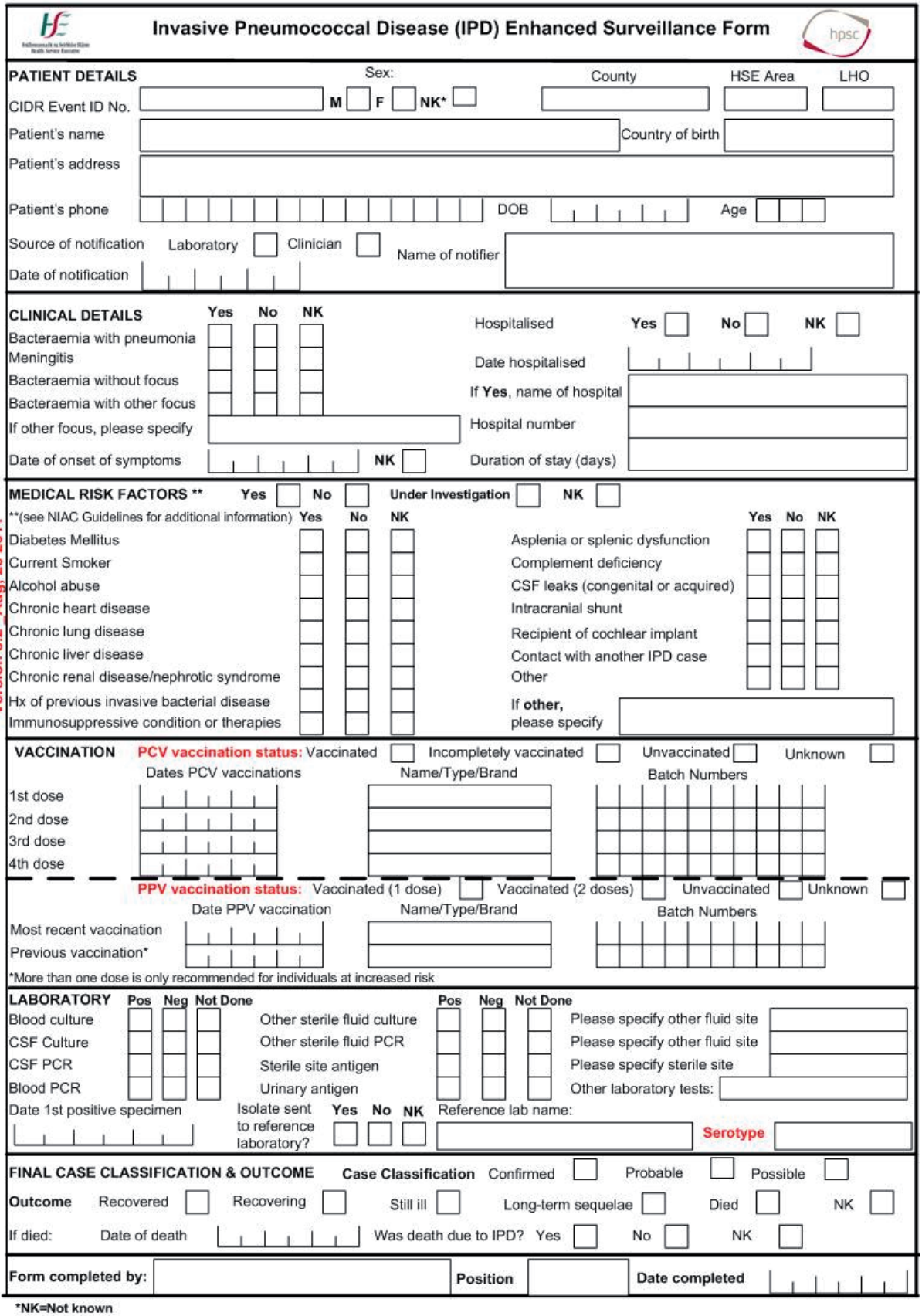
3rd Dose Batch No.

Comments:

Signature: **Position** **Date:**

For Bacterial meningitis caused by *H. influenzae* or *S. pneumoniae* please use disease-specific enhanced forms on HPSC website.
If you have direct access to CIDR, please enter these enhanced data, if not forward this form to:
Director of the Health Protection Surveillance Centre; Fax: 01-8561299

Invasive pneumococcal disease (Sample)



Invasive Pneumococcal Disease (IPD) Enhanced Surveillance Form

hpsc

PATIENT DETAILS Sex: M ☐ F ☐ NK* ☐ | County | HSE Area | LHO

CIDR Event ID No. | Patient's name | Country of birth | Patient's address | Patient's phone | DOB | Age

Source of notification: Laboratory ☐ Clinician ☐ | Name of notifier

Date of notification

CLINICAL DETAILS

	Yes	No	NK
Bacteraemia with pneumonia			
Meningitis			
Bacteraemia without focus			
Bacteraemia with other focus			

If other focus, please specify

Date of onset of symptoms | NK ☐

Hospitalised: Yes ☐ No ☐ NK ☐

Date hospitalised

If **Yes**, name of hospital

Hospital number

Duration of stay (days)

MEDICAL RISK FACTORS ** Yes ☐ No ☐ Under Investigation ☐ NK ☐

**(see NIAC Guidelines for additional information)

	Yes	No	NK
Diabetes Mellitus			
Current Smoker			
Alcohol abuse			
Chronic heart disease			
Chronic lung disease			
Chronic liver disease			
Chronic renal disease/nephrotic syndrome			
Hx of previous invasive bacterial disease			
Immunosuppressive condition or therapies			
Asplenia or splenic dysfunction			
Complement deficiency			
CSF leaks (congenital or acquired)			
Intracranial shunt			
Recipient of cochlear implant			
Contact with another IPD case			
Other			

If **other**, please specify

Version 8.2_Aug_29 2011

VACCINATION PCV vaccination status: Vaccinated ☐ Incompletely vaccinated ☐ Unvaccinated ☐ Unknown ☐

	Dates PCV vaccinations	Name/Type/Brand	Batch Numbers
1st dose			
2nd dose			
3rd dose			
4th dose			

PPV vaccination status: Vaccinated (1 dose) ☐ Vaccinated (2 doses) ☐ Unvaccinated ☐ Unknown ☐

	Date PPV vaccination	Name/Type/Brand	Batch Numbers
Most recent vaccination			
Previous vaccination*			

*More than one dose is only recommended for individuals at increased risk

LABORATORY

	Pos	Neg	Not Done
Blood culture			
CSF Culture			
CSF PCR			
Blood PCR			

	Pos	Neg	Not Done
Other sterile fluid culture			
Other sterile fluid PCR			
Sterile site antigen			
Urinary antigen			

Please specify other fluid site

Please specify other fluid site

Please specify sterile site

Other laboratory tests:

Date 1st positive specimen

Isolate sent to reference laboratory? Yes ☐ No ☐ NK ☐

Reference lab name:

Serotype

FINAL CASE CLASSIFICATION & OUTCOME Case Classification: Confirmed ☐ Probable ☐ Possible ☐

Outcome: Recovered ☐ Recovering ☐ Still ill ☐ Long-term sequelae ☐ Died ☐ NK ☐

If died: Date of death | Was death due to IPD? Yes ☐ No ☐ NK ☐

Form completed by: | **Position** | **Date completed**

***NK=Not known**

Invasive Pneumococcal Disease - Enhanced Surveillance Form (page 2)

For Local HSE Area Use Only

FURTHER PATIENT DETAILS

Parent/guardian details

Parent/guardian name

Parent/guardian phone

GP details

GP's name

GP's address

GP's phone

Hospital details (Hospital name, see page 1 of form) If hospitalised please complete the following

Ward name

Consultant name

Follow-up Notes

Was vaccination recommended? Yes ☐ No ☐ Unk ☐

Was vaccination initiated as per NIAC recommendations? Yes ☐ No ☐ Unk ☐

	Yes	No	Unk
Immunological assessment recommended?	☐	☐	☐
Immunological assessment undertaken?	☐	☐	☐

Immunoglobulin assay results (IgG, IgM, IgA)

	Normal	Abnormal	Unk
IgG	☐	☐	☐
IgM	☐	☐	☐
IgA	☐	☐	☐

Complement assays (C1, C2, C3, C4, CH50)

	Normal	Abnormal	Unk
C1	☐	☐	☐
C2	☐	☐	☐
C3	☐	☐	☐
C4	☐	☐	☐
CH50	☐	☐	☐

Serotype specific pneumococcal antibody ☐ **Date taken (1)**

Serotype specific pneumococcal antibody ☐ **Date taken (2)**

Comments/Other notes

Thank you for completing this form. Please return the completed form to your local Department of Public Health

Version 8.2 _Aug, 29 2011

Invasive Haemophilus influenzae (Sample)

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Surveillance Form for Invasive *Haemophilus influenzae*

hpsc

Patient Details:

Patient Name/Initials* | Patient Address** | County

HSE Area | Hospital Name | Hospital Number

DOB | Age | Sex: Male ☐ Female ☐ Not Known ☐

Clinical Diagnosis

Meningitis	☐	Septic Arthritis	☐	**If "Other" please give details**
Epiglottitis	☐	Osteomyelitis	☐	
Pneumonia	☐	Cellulitis	☐	
Bacteraemia (without focus)	☐	Other	☐	

Date of Admission to Hospital | **Outcome:** Recovered ☐ Died ☐ Not Known ☐

Risk Factors for Infection (If known):

* Initials only to be sent to HPSC ** For HSE Area use only

Microbiology Data:

Date of 1st positive specimen | Method of confirmation: Culture ☐ Antigen ☐ Other ☐

If antigen test or other, please specify:

Source of Isolate: Blood ☐ CSF ☐ Joint ☐ Other (please specify)

Organism name and type:

	Yes	No	Unknown
Isolate sent to reference laboratory?	☐	☐	☐
PCR performed?	☐	☐	☐

Name of Microbiologist: | Hospital:

Vaccination Data:

HIB Vaccination Status: Vaccinated ☐ Incompletely Vaccinated ☐ Unvaccinated ☐ Unknown ☐

	Dates of Hib vaccinations:	**Type/Brand**	**Batch numbers**
1st			
2nd			
3rd			
4th			

Name of other vaccinations given at the same time?	**Type/Brand**	**Batch numbers**
1st		
2nd		
3rd		
4th		

Form completed by: | Date of completion:

Contacts' recording form (sample)

Name of index case _____

Address _____ **Telephone** _____ **CIDR ID number** _____

Locations assessed – Home ☐ **Crèche** ☐ **School** ☐ **College dormitory/residence** ☐ **Recreational activity (with close contact)** ☐

Other ☐ **Specify** _____

Contact name	Type contact (household, other)	Chemoprophylaxis recommended (yes/no)	Who administered? (GP/PH/Hospital)	Vaccination recommended (yes/no)	Address	Telephone number	Mobile number	Other comment

IPD cluster investigation form (Sample)

Section 1: Cluster details

Location/name of premises
Total number and clinical features of cases:

	Total no.	Meningitis	Pneumonia	Bacteraemia	Empyema	Other
Confirmed cases						
Probable cases						
Possible cases						

Date of onset: First case __/__/__ Last case __/__/__

Have any of the confirmed cases been serotyped? ☐, If yes, what serotype(s) _____

Section 2: Type of setting (tick as appropriate)

Child day-care ☐ Care home ☐
Pre-school ☐ Hospital ☐
School ☐ Prison ☐
Household ☐ Military establishment ☐
Other closed setting (please describe) _____

Section 3: Population at risk and action taken (tick as appropriate)

Number of persons in the establishment _____

Antibiotics given ☐ If yes, date __/__/__ How many? __ Name _____

PPV given ☐ If yes, date __/__/__ How many? __

PCV given ☐ If yes, date __/__/__ How many? __

How many pneumococcal cases occurred after the intervention? ____

Section 4: Nasopharyngeal swabbing of contacts (tick as appropriate)

Undertaken before ☐ If yes, date __/__/__ How many swabbed? __

If yes, how many were positive for *Streptococcus pneumoniae*? ____

Undertaken after ☐ If yes, date __/__/__ How many swabbed? __

If yes, how many were positive for *Streptococcus pneumoniae*? ____
How many were positive for the cluster serotype _____

Section 5: Additional comments

Source HPA

APPENDIX 4
Examples of Chemoprophylaxis Information

The following examples of letters and leaflets can be adapted locally to reflect specifics appropriate to community, situation, and disease type.

The following examples of drug information leaflets are provided:

- Rifampicin
    - Child
    - Adult
- Ceftriaxone
- Ciprofloxacin.

Example

RIFAMPICIN – ADULT

PLEASE READ THIS INFORMATION BEFORE STARTING RIFAMPICIN

What is Rifampicin?

You have been prescribed the antibiotic called Rifampicin. It comes as a tablet or syrup. It is suitable for people of all ages and is a well-known antibiotic used to treat many different conditions.

Why have I been advised to take this antibiotic?

You have been in close contact with a suspected case of Meningococcal disease. Meningococcal disease may cause meningitis or septicaemia (blood poisoning). The risk of catching the infection from a case is extremely low. The Meningococcal germ can be carried in the nose and throat. This antibiotic will kill those germs.

Will this antibiotic eliminate the possibility of developing meningitis or septicaemia?

Taking the antibiotic will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms. You might also be recommended vaccination if appropriate.

How should I take the antibiotic?

It is important that you take the antibiotic as instructed.

The medicine should ideally be taken about 30 minutes before food or 2 hours afterwards to ensure that it is fully active in your body.

The complete course requires you to take 4 doses of the antibiotic and will last for 2 days. Each dose should be taken 12 hours after the previous dose. It is essential that you complete the 2-day course.

Before starting the antibiotics, is there anything I should let the doctor know?

Please remember to inform the public health doctor before taking this antibiotic:

- If you are taking any other medication e.g. for epilepsy or blood thinning medication
- If you have a liver problem
- If you have any drug allergies (including Rifampicin)
- If you are pregnant or suspect you may be pregnant
- If you are on hormonal contraceptives (females). These contraceptives include the oral contraceptive pill, contraceptive patches and implants).

The doctor may have to arrange for you to have a different antibiotic.

Can this antibiotic interfere with the contraceptives ("The Pill" or "The Mini-Pill" or "patches" or "contraceptive implants" e.g. implanon)?

Yes, rifampicin can interfere with these hormonal contraceptives. If you are on any of these please speak with the doctor as an alternative antibiotic (ciprofloxacin) may be a better choice for you as it does not interfere with the oral contraceptive pill.

If you are on a hormonal contraceptive and are still recommended Rifampicin

Rifampicin can interfere with the effectiveness of hormonal contraceptives ("The Pill" or "The Mini-Pill" or "patches" or "contraceptive implants" e.g. implanon) while you are taking the antibiotic and for up to four weeks after.. If you are on an oral contraceptive pill (OCP) you should continue to take the OCP, omitting any pill free interval while

taking rifampicin and for the seven days after the last dose of rifampicin. All users of hormonal contraceptives should use additional alternative precautions (e.g. condoms) while you are taking the antibiotic and for up to four weeks after.

What side effects may I experience while taking the antibiotic?

Most people who take Rifampicin do not experience any difficulties with it. The possible side effects of Rifampicin include:

- Orange/red staining of urine, tears, sweat, saliva and faeces for a few days- this is normal
- Soft contact lenses may become permanently discoloured so should not be worn while taking the antibiotic and for one week after completing the treatment.
- Tummy upset, diarrhoea and nausea
- Skin flushing and itching with or without a rash
- Very rarely, jaundice (yellowing of the skin or whites of the eyes)
- Reduction of effect of blood thinning medication (anticoagulants), diabetic medication, some types of epilepsy medication

Further information on the drug Rifampicin is contained in the Product Information Leaflet inside the pack.

What your doctor needs to know

Your family doctor will be informed that you have been advised to take these antibiotics.

If you or any member of the family develop fever, headache, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure, dizziness or any other symptoms mentioned in the enclosed leaflet on meningococcal disease, contact your family doctor immediately and bring this leaflet with you.

If you have any queries, please contact one of the Public Health doctors at the number above.

Yours sincerely,

Senior Medical Officer

Example

RIFAMPICIN –CHILD

PLEASE READ THIS LEAFLET BEFORE YOUR CHILD STARTS THE ANTIBIOTIC RIFAMPICIN

What is Rifampicin?

Your child has been prescribed the antibiotic called Rifampicin. It comes as a tablet or syrup. It is suitable for people of all ages and is a well-known antibiotic used to treat many different conditions.

Why has my child been advised to take this antibiotic?

Your child has been in close contact with a suspected case of Meningococcal disease. Meningococcal disease may cause meningitis or septicaemia (blood poisoning). The risk of catching the infection from a case is extremely low. The Meningococcal germ can be carried in the nose and throat. This antibiotic will kill those germs.

Will this antibiotic eliminate the possibility of developing meningitis or septicaemia?

Taking the antibiotic will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms. Your child might also be recommended a vaccine if needed.

How should my child take the antibiotic?

It is important that your child take the antibiotic as instructed.

- The medicine should ideally be taken about **30 minutes before food or 2 hours afterwards** to ensure that it is fully active in their body.
- The complete course requires your child to take 4 doses of the antibiotic and will last for 2 days.
- Each dose should be taken 12 hours after the previous dose. **It is essential that your child complete the 2-day course**.

Before starting the antibiotics, is there anything I should let the doctor know?

Please remember to inform the public health doctor before taking this antibiotic:

- If your child is taking any other medication e.g. for epilepsy, blood thinning medication, hormonal contraceptive,
- If your child has a liver problem
- If your child has any drug allergies
- If any of these apply, the doctor may have to arrange for your child to have a different antibiotic.

What side effects may my child experience while taking the antibiotic?

Most people who take Rifampicin do not experience any difficulties with it. The possible side effects of Rifampicin include:

Orange/red staining of urine, tears, sweat, saliva and faeces for a few days- **this is normal**

- Soft contact lenses may become permanently discoloured so should not be worn while taking the antibiotic and for one week after completing the treatment.
- Tummy upset, diarrhoea and nausea.
- Skin flushing and itching with or without a rash.
- Very rarely, jaundice (yellowing of the skin or whites of the eyes)
- Reduction of effect of blood thinning medication (anticoagulants), diabetic medication, some types of epilepsy medication

Further information on the drug Rifampicin is contained in the Product Information Leaflet inside the pack

What your doctor needs to know

Your family doctor will be informed that your child have been advised to take these antibiotics.

If you, your child or any member of the family develop fever, headache, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure, dizziness or any other symptoms mentioned in the enclosed leaflet on meningococcal disease, contact your family doctor immediately **and bring this letter with you.**

If you have any queries, please contact one of the Public Health doctors at the number above.

Yours sincerely,

Example

CEFTRIAXONE

PLEASE READ THIS LEAFLET BEFORE STARTING CEFTRIAXONE

What is Ceftriaxone?
The antibiotic you have been advised to take is called Ceftiaxone. It comes as an injection. It is suitable for people of all ages and is a well-known antibiotic used to treat many different conditions.

Why have I been advised to take this antibiotic?
You have been in close contact with a suspected case of Meningococcal disease. Meningococcal disease may cause meningitis or septicaemia (blood poisoning). The risk of catching the infection from a case is extremely low. The Meningococcal germ can be carried in the nose and throat. This antibiotic will kill those germs.

But I'm pregnant – should I take the antibiotic?
No drug can be regarded as completely safe in pregnancy. But harmful effects to the foetus have not been documented in relation to this antibiotic.

Will this antibiotic eliminate the possibility of developing meningitis or septicaemia?
Taking the antibiotic will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms. Only one dose will be administered. You might also be recommended vaccination if needed.

How should I take the antibiotic?
The antibiotic is given by injection. Only one dose is required.

Before starting the antibiotics, is there anything I should let the doctor know?
Please remember to inform the public health doctor before taking this antibiotic:

- If you are taking any other medication
- If you a liver or kidney condition, have other illnesses or are on a low sodium diet
- If you have any drug allergies

What side effects may I experience while taking the antibiotic?
Most people who take Ceftriaxone do not experience any difficulties with it. The possible side effects of Ceftriaxone include:

- Loose stools and diarrhoea, or occasionally nausea and vomiting
- Skin rash
- Pain or discomfort may be experienced at the site of the injection immediately after the injection but this is usually well tolerated and passes quickly

Further information on the drug Ceftriaxone is contained in the Product Information Leaflet inside the pack.

What your doctor needs to know
Your family doctor (and obstetrician if required) will be informed that you have been advised to take these antibiotics. If you or any member of the family develop fever, headache, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure, dizziness or any other symptoms mentioned in the enclosed leaflet on meningococcal disease, contact your family doctor immediately and bring this letter with you.

If you have any queries, please contact one of the Public Health doctors at the number above.

Yours sincerely,

Senior Medical Officer

Example

CIPROFLOXACIN

PLEASE READ THIS LEAFLET BEFORE TAKING **CIPROFLOXACIN**

What is Ciprofloxacin?
The antibiotic you have been advised to take is called Ciprofloxacin. It comes as a tablet. It is a well-known antibiotic used to treat many different conditions.

Why have I been advised to take this antibiotic?
You have been in close contact with a suspected case of Meningococcal disease. Meningococcal disease may cause meningitis or septicaemia (blood poisoning). The risk of catching the infection from a case is extremely low. The Meningococcal germ can be carried in the nose and throat. This antibiotic will kill those germs.

Will this antibiotic eliminate the possibility of developing meningitis or septicaemia?
Taking the antibiotic will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms. Only one dose will be administered. You might also be recommended vaccination if needed.

How should I take the antibiotic?

- You will be given either one or two tablets to take as a one-off dose. It is important that you take the tablets as directed.
- **The tablets should be swallowed whole with a full glass of water**. You should try to take plenty of liquids after, provided you do not have a kidney or heart problem.
- **Do not take alcohol with this medicine** as it may make you drowsy affecting your ability to drive or operate machinery.
- It should not be taken within 4 hours of taking antacid/indigestion medicines or medicines containing iron or mineral supplements. These medications may prevent your body from absorbing the full dose.

Before starting the antibiotics, is there anything I should let the doctor know?
Please remember to inform the public health doctor before taking this antibiotic:
If you are taking any other medication, particularly antacid/indigestion tablets, medicines containing iron or mineral supplements, anticoagulant (blood thinning) tablets, diabetic medication, cyclosporine or long acting asthma drugs.

- If you have any drug allergies
- If you have any kidney or liver problems, or the hereditary condition G6PD deficiency
- If you are pregnant or breast feeding
- If you have any of the above tell the doctor as he/she may have to arrange for you to have a different antibiotic

What side effects may I experience while taking the antibiotic?
Most people who take Ciprofloxacin do not experience any difficulties with it. The possible side effects of Ciprofloxacin include:

- Tummy ache, diarrhoea and nausea
- Pain and swelling around the tendons
- Tiredness, dizziness, rash, headache
- Facial swelling. This is not serious and will generally subside over a period of about half an hour. If you experience this, please tell your doctor immediately.
- Rarely breathing difficulties are associated with the facial swelling. You should seek medical attention urgently if this occurs.

Further information on the drug Ciprofloxacin is contained in the Product Information Leaflet.

What your GP needs to know
Your family doctor will be informed that you have been advised to take these antibiotics.
If you or any member of the family develop fever, headache, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure, dizziness or any other symptoms mentioned in the enclosed leaflet on meningococcal disease, contact your family doctor immediately and bring this letter with you.

If you have any queries, please contact one of the Public Health doctors at the number above.

Yours sincerely,

Senior Medical Officer

APPENDIX 5

Examples of Vaccination Information

The following examples of letters and leaflets can be adapted locally to reflect specifics appropriate to community, situation and disease type.

The following examples are provided

- Meningococcal B vaccine
- Meningococcal C vaccine
- Meningococcal vaccine – group $ACW_{135}Y$- conjugate vaccine.

MenB- immunisation against meningococcal disease - group B

Why vaccination?
Meningococcal disease may cause meningitis or septicaemia (blood poisoning). Following close contact with a suspected case of Meningococcal disease, there is an extremely low risk of catching the infection. Immunisation with a vaccine is recommended for adults and children of two months of age and over who are close contacts of a case of meningococcal disease caused by Group B strain of the meningococcal germ. This is generally given in addition to antibiotics.

Immunisation is recommended for children from two months of age, and for at risk adults. Children up to 1 year of age require two doses of vaccine at least two months apart and a further dose at 12 months of age. Unvaccinated children over 12 months/adolescents/adults only need two doses.

Will this vaccination eliminate the possibility of developing meningitis or septicaemia?
Undergoing vaccination will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms.

Before undergoing vaccination, is there anything I should let the doctor know?

- Pregnancy – although there is no evidence that this vaccine is unsafe during pregnancy, it should not be given unless there is a high risk of the individual developing the disease.
- Acute febrile illness – vaccination should be postponed.
- Those who have had a severe systemic reaction to a previous dose of the vaccine or to any constituent of the vaccine.

What are the possible side effects from vaccination?

- Most people who undergo vaccination do not experience any difficulties with it. There are possible side effects:
- Generalised reactions are rare.
- Injection site reactions, such as a small lump, redness, swelling or itch, may occur and last approximately 24-48 hours.
- If you or your child develops side effects following vaccination and you are concerned, it is advisable to seek medical advice.

What your GP needs to know
We will let your GP know that you received the vaccine but in future years, if you (or your family) are ever in contact with meningococcal disease again, please inform the doctor that you have received the vaccine and the approximate date that you received the vaccine. Therefore it is very important that you should still remain alert for the symptoms and signs of meningococcal disease (as outlined in the leaflet) and seek medical help as early as possible if you are concerned.

If your child is aged less than 12 months, please ensure that he/she completes the course of three doses recommended as part of the childhood immunisation programme (third dose at 12 months).

Yours sincerely,

_____
Senior Medical Officer

Example

MENC- IMMUNISATION AGAINST MENINGOCOCCAL DISEASE - GROUP C

Why vaccination?

Meningococcal disease may cause meningitis or septicaemia (blood poisoning). Following close contact with a suspected case of Meningococcal disease, there is an extremely low risk of catching the infection. Immunisation with a vaccine is recommended for adults and children of two months of age and over who are close contacts of a case of meningococcal disease caused by **Group C strain** of the meningococcal germ. This is generally given in addition to antibiotics.

mmunisation is recommended for children from two months of age, and for adults. Children up to 1 year of age require one dose of vaccine and a further dose at 13 months of age. Close contacts who are partially immunised should complete the course of vaccine. Children or adults who received a MenC vaccine more than one year before are recommended a booster.

Will this vaccination eliminate the possibility of developing meningitis or septicaemia?

Undergoing vaccination will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms.

Before undergoing vaccination, is there anything I should let the doctor know?

- Pregnancy – although there is no evidence that this vaccine is unsafe during pregnancy, it should not be given unless there is a high risk of the individual developing the disease.
- Acute febrile illness – vaccination should be postponed.
- Those who have had a severe systemic reaction to a previous dose of the vaccine or to any constituent of the vaccine including meningococcal C polysaccharide, diphtheria toxoid or the CRM197 carrier protein (contained in both of the currently available MenC vaccines and in the Hib vaccine).

What are the possible side effects from vaccination?

- Most people who undergo vaccination do not experience any difficulties with it.
- Generalised reactions are rare.
- Injection site reactions, such as a small lump, redness, swelling or itch, may occur and last approximately 24-48 hours.
- If you or your child develops side effects following vaccination and you are concerned, it is advisable to seek medical advice.

What your GP needs to know

We will let your GP know that you received the vaccine but in future years, if you (or your family) are ever in contact with meningococcal disease again, please inform the doctor that you have received the vaccine and the approximate date that you received the vaccine. Therefore it is very important that you should still remain alert for the symptoms and signs of meningococcal disease (as outlined in the leaflet) and seek medical help as early as possible if you are concerned.

If your child is aged less than 12 months, please ensure that he/she completes the course of doses recommended as part of the childhood immunisation programme.

Yours sincerely,

Senior Medical Officer

Example

MENINGOCOCCAL VACCINE – GROUP A,C,W_{135},Y – CONJUGATE VACCINE

IMMUNISATION AGAINST MENINGOCOCCAL DISEASE - GROUP A, C, W_{135}, Y VACCINE

Why vaccination?
Meningococcal disease may cause meningitis or septicaemia (blood poisoning). Following close contact with a suspected case of Meningococcal disease, there is and extremely low risk of catching the infection. Immunisation with the A,C,Y, W_{135} vaccine is recommended for adults and children who are close contacts of a case of meningococcal disease caused by **Group A, W_{135} or Y strain** of the meningococcal germ. This generally is given in addition to antibiotics.

Menveo® vaccine is the name of the vaccine currently recommended after exposure to an individual diagnosed with group A, W_{135} or Y meningococcal disease. Other quadrivalent meningococcal vaccines may also be used if Menveo® is not available.

Menveo® can be given from the age of two months. Two doses of Menveo®, given at one month intervals, are needed for children who are less than one year of age. Only one dose is needed for individuals older than 12 months.

This vaccine is also recommended for individuals undertaking the Hajj pilgrimage to Mecca.

What is the response to vaccination?
Following vaccination, antibodies develop that will protect the individual. It may take up to one month to develop the antibodies.

Will this vaccination eliminate the possibility of developing meningitis or septicaemia?
Undergoing vaccination will reduce the possibility of developing meningitis or septicaemia. But it will not completely eliminate this possibility; so do remain alert for the development of symptoms.

Before undergoing vaccination, is there anything I should let the doctor know?
Vaccination should be postponed in individuals suffering from an acute febrile illness or in pregnant women; hypersensitivity to the vaccine or any of its components; if you are pregnant or breastfeeding

What are the possible side effects from vaccination?
Most people who undergo vaccination do not experience any difficulties with it. There are possible side effects including localised redness can occur lasting 1-2 days at the site of the injection. If you or your child develops side effects following vaccination and you are concerned, it is advisable to seek medical advice.

If you (or your family) are ever in contact with meningococcal disease again, please inform the doctor that you have received the vaccine and the approximate date that you received the vaccine. You can keep this letter as a record.

This vaccine will only protect you against A, C,W135 and Y groups. Therefore it is very important that you should still remain alert for the symptoms and signs of meningococcal disease (as outlined in the leaflet) and seek medical help as early as possible if you are concerned.

Yours sincerely,

Senior Medical Officer

Vaccination administration record for patient

This record should be given to the patient at the time of vaccination, to hold for their own files. Alternatively, if they have an immunisation book the vaccine can be entered there, as a record of their immunisation.

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Patient Name _____

Patient date of Birth _____

Vaccine	Type[1]	Date given (dd/mm/yyyy)	Site[2]	Batch number	Manufacturer name	Leaflet given (√)	Vaccinator signature
Meningococcal vaccine							

How to complete this record for the patient

1. Record the vaccine type (MenB, MenC, MenACW$_{135}$, Y, or other) or the trade name for each vaccine (see table at right).
2. Record the site where vaccine was administered as either RA (right arm), LA (left arm), RT (right thigh), LT (left thigh).
3. Record whether leaflet was given to the patient/parent/guardian.

Date: June 2011 from Clinical Guidelines for Bacterial Meningitis

APPENDIX 6.
Examples of Templates for Letters

For schools re contact with case, prophylaxis etc.

The following examples can be modified to suit local needs and are given only as examples.

GP whose Patients were Close Contacts and Given Chemoprophylaxis

Dr. _____ Date: ___/___/____

_____

_____

Dear Doctor,

Your patients below were given Rifampicin/Ciprofloxacin/Ceftriaxone today as close contacts of a recent case of Meningococcal Meningitis:

	Name	DOB	Address
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Signed:

Senior Medical Officer

Letter to GP re Rifampicin and Warfarin /Anticonvulsants

Date: ____/____/_____

RE: _____ DOB __/__/____

Dear Doctor,

It has come to our attention that your patient (above) was a close contact of a case of meningococcal disease.

We have given a two day course of rifampicin as prophylaxis along with instructions. We understand that this patient is currently taking *Warfarin/anticonvulsant*. Rifampicin may accelerate the metabolism and may reduce the activity of oral anticoagulants or anticonvulsants.

We have also supplied an information leaflet on meningococcal disease.

Yours sincerely,

Senior Medical Officer

Letter to GP listing patients who have received meningococcal vaccine

_____
_____
_____
_____

Dear Doctor

Your patients listed below were given _____today as close contacts of a recent case of Meningococcal Disease **Type:** _____

Date of vaccination	Name	DOB	Address	Name of vaccine

If you have any queries regarding this, please contact one of the public health doctors at the above number

Yours sincerely,

Senior Medical Officer

Letter informing GP of a case of meningococcal disease in the locality

Date __/__/__

Dear Doctor,

A case of meningococcal disease from your locality has recently been notified, in a baby/ pre-school child/school child/young adult/adult.

It is recommended that when meningococcal infection is suspected, **a single dose of benzylpenicillin** should be given **immediately** intramuscularly or (preferably) intravenously.

An appropriate dose is-

For adults and children 10 years and over	1200 mg (2 mega units)
For children aged 1 - 9 years	600 mg
For infants	300 mg

Yours sincerely,

Senior Medical Officer

Letter to parents informing them of case of meningococcal disease in their child's school

Date __/__/__

Dear Parent,

I wish to inform you that a case of meningococcal disease has occurred in a child who attends your child's school_____.

While it is very unlikely that there will be further cases in the school it is important to be aware of the symptoms of this illness – these include **headache, high temperature, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure and dizziness**.

Some or all of the above symptoms may be present. Seek medical attention without delay if you are concerned.

The enclosed leaflet will give you further information about the disease.

Should you need any further information, please contact your general practitioner or a public health doctor at the above address/phone number.

Yours sincerely,

Senior Medical Officer

Letter informing student of meningococcal case in his/her college

Date __/__/__

Dear Student,

I wish to inform you that a case of meningococcal disease has occurred in a student at your college _____.

While it is very unlikely that there will be further cases in the college, it is important to be aware of the symptoms of this illness - these include headache, high temperature, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure and dizziness.

Some or all of the above symptoms may be present. Seek medical attention without delay if you are concerned.

The enclosed leaflet will give you further information about the disease.

Should you need any further information, please contact your student health services, general practitioner or a public health doctor at the above address/phone number.

Yours sincerely,

Senior Medical Officer

Workplace letter

Letter informing workplace colleagues of a case of meningococcal disease

Date __/__/__

To whom it may concern:

I wish to inform you that a case of meningococcal disease has occurred in a person at your workplace.

While it is very unlikely that there will be further cases in your workplace, it is important to be aware of the symptoms of this illness – these include headache, high temperature, vomiting, neck pain, dislike of bright lights, a red purple rash which does not fade on pressure and dizziness.

Some or all of the above symptoms may be present. Seek medical attention without delay if you are concerned.

The enclosed leaflet will give you further information about the disease.

Should you need any further information, please contact your general practitioner or a public health doctor at the above address/phone number.

Yours sincerely,

Senior Medical Officer

APPENDIX 7.

Examples of Disease Information Leaflets

Meningococcal disease – meningitis or septicaemia

Meningococcal disease is the most common cause of meningitis in Ireland. Other causes of meningitis include pneumococcal disease, Hib and group B streptococcal disease.

What is meningitis?
Meningitis is an inflammation of the meninges, which is the name given to the covering layer of the brain and spinal cord.

What is septicaemia?
Septicaemia is a form of blood poisoning caused by the same organism that causes meningitis.

What causes invasive meningococcal disease?
Neisseria meningitidis is the name of the bacteria that is responsible. There are several different types of *Neisseria meningitidis*, these include groups A, B, C, W_{135} and Y. Group B disease is now the most common form seen in Ireland.

Symptoms and signs in adults and older children
Classical symptoms and signs would include temperature, severe headache, neck stiffness, nausea and/or vomiting, dislike of bright lights, drowsiness and joint or muscle pains. The patient may be confused and disoriented or have fitting episodes. Not all of these symptoms may appear.

Symptoms and signs in babies and infants
Classical symptoms and signs of meningitis such as dislike of bright lights and neck stiffness are uncommon and difficult to determine in infants and small children. Do not underestimate a parental instinct that "something is wrong".

Both adults and babies may have a **rash**. If bacteria enter the bloodstream, they can release toxins, which can damage the walls of blood vessels causing a leakage of blood under the skin. The appearance of the rash can vary. It may start as tiny blood spots which look like red pin-prick type marks which if untreated can spread to form bruises or blood blisters. **Do not wait for a rash to appear**. It may be the last sign to appear and it can spread very quickly. If you see or suspect a rash seek medical attention immediately.

How do you get invasive meningococcal disease?
The bacteria which cause meningococcal meningitis and meningococcal septicaemia are common and can live naturally in the back of the nose and throat. It is spread by respiratory droplets, which are most efficiently generated by coughing, sneezing and mouth kissing. Depending on the age group, up to 1 in 10 people may carry this bacteria. Carriage is uncommon in infancy and early childhood but increases with age. Peak carriage rates may occur in the 15-19 year old group of whom 25% are carriers. Carriage is typically followed by the development of immunity. Only a small minority of carriers will develop meningitis or septicaemia after an incubation period of 2-3 days. Why some people develop meningitis and others don't is not fully known but it is believed that on occasion the bacteria can overcome the body's immune system and cause meningitis and meningococcal septicaemia.

Who is most at risk?
Invasive meningococcal disease may occur at any age but is most common in infancy and early childhood with an additional smaller peak of disease activity in adolescents and young adults. In Ireland the infection typically shows a seasonal variation with the majority of cases occurring in winter and early spring.

Can invasive meningococcal disease be treated?
Yes. The earlier the diagnosis, the earlier treatment with antibiotics can begin and therefore the greater chance that the person will make a full recovery. Early diagnosis is the key so if you suspect that someone may have meningitis or septicaemia seek medical attention immediately.

Is there a vaccine available for meningococcal meningitis?
Vaccines are available for some of the different types of *Neisseria meningitidis* bacteria,
There is a vaccine to prevent MenC disease that is given routinely in infancy at 4, 6 and 13 months of age. All children should routinely get this vaccine.

There is also a vaccine that is used to protect against groups A, B, C, W_{135} and Y that is recommended for individuals travelling to areas where there is an increased risk of exposure to these groups.

What is the treatment?
Meningococcal disease can be treated with effective antibiotics, but it is important that these are started as soon as possible. If symptoms occur, the patient should see a doctor immediately.

Are contacts of people with meningococcal disease at risk?
Not all contacts are at increased risk. It depends on the type of contact. People who are very close contacts (such as family contacts or other close contact) of the ill person are given antibiotics (one dose or a very short course) in order to prevent further cases of the illness. These antibiotics will also kill the bacteria that normally help the body fight infection, so they are only given when absolutely necessary.

Meningitis and meningococcal septicaemia need URGENT medical attention.

Invasive pneumococcal disease – meningitis or septicaemia

What is pneumococcal disease?
Pneumococcal disease is caused by a bacterium called *Streptococcus pneumoniae*. This bacterium is the most common bacterial cause of community-acquired pneumonia and a common cause of bacteraemia and meningitis in children and adults. There are over 90 types of *S. pneumoniae* known (these are called serotypes).

What diseases does pneumococcus cause?
The most common types of infections caused by *S. pneumoniae* include:

- Middle ear infections (acute otitis media), particularly common in children
- Pneumonia
- Bacteraemia (blood stream infection)
- Sinus infections and
- Meningitis

How common is pneumococcal disease?
Pneumococcal infection is a leading cause of death worldwide. Mortality is highest in patients who develop bacteraemia or meningitis. Pneumococcal pneumonia is estimated to affect 0.1% of the population every year.

Who is most at risk of pneumococcal disease?
Individuals most at risk of pneumococcal infections are

- the very young or the very old
- people with a chronic illness such as diseases of heart, lung, kidneys or liver
- people without a spleen or with a damaged spleen
- people whose immune system is not working properly.

How do people get infected?
People can get infected by person-to-person spread, usually through respiratory droplet spread, but may be by direct oral contact or indirectly through articles contaminated with respiratory discharges. The bacteria is spread through contact between persons who are ill or who carry the bacteria in their throat (often without being ill). It is extremely rare for healthy people to catch the infection from a relative or a member of their household.

How is pneumococcal disease treated?
Pneumococcal disease is treated with antibiotics. In recent years many pneumococci have become resistant to some of the antibiotics used to treat pneumococcal infections; high levels of resistance to penicillin are uncommon.

How is pneumococcal disease prevented?
The most common types of pneumococcal disease can be prevented by vaccination. Vaccination is recommended for those most at risk of disease. Since 2008 all children are recommended the pneumococcal vaccine.

Pneumococcal vaccines
There are two different types of pneumococcal vaccine:
1. Pneumococcal Polysaccharide Vaccine (PPV23). This incorporates 23 of the most common strains of pneumococcus. It is only suitable for use in those ≥2 years of age.

2. Pneumococcal Conjugate Vaccines are used in the childhood immunisation schedule at 2, 6, and 12 months. The vaccine currently used protects against 13 strains. These vaccines are used in children because they are more suitable for children than the polysaccharide vaccines.

Are close contacts ever offered antibiotics?
If two or more cases of serious pneumococcal disease are identified in a closed setting (household, school or other closed environment) there may be a slightly increased risk of developing the infection among the close contacts. In these circumstances close contacts may be offered antibiotics and sometimes immunisation as a precautionary measure if appropriate.

For further information please contact: (insert as appropriate)

Haemophilus influenzae type b disease

See leaflet on NIO or HPSC website:

https://www.hpsc.ie/A-Z/VaccinePreventable/Haemophilusinfluenzae/Factsheets

Viral meningitis

What is viral meningitis?
Viral meningitis is the commonest type and is most frequently seen in children. It is a milder disease than bacterial meningitis and is rarely fatal. People with viral meningitis may have severe symptoms but they usually recover completely. There is no specific drug treatment for viral meningitis.

What are the symptoms of viral meningitis?
The symptoms of viral meningitis may include:

- High temperature
- Severe headache
- Stiff neck
- Bright lights hurt the eyes
- Drowsiness
- Confusion
- Nausea and vomiting

The symptoms in young babies may be more difficult to identify and include high temperature, irritability, difficulty in waking the baby from sleep and refusing to eat. The symptoms of bacterial meningitis may be identical, particularly in the early stages of the disease. For this reason it is important that if you think that your child may have meningitis you should contact your doctor as soon as possible.

How is viral meningitis spread?
The viruses that cause viral meningitis are contagious and can be easily spread from person to person. However, most people who get infected with these viruses do not become ill, or else just develop a mild cold or rash with a slight fever. Less than 1 in 1000 people infected with these viruses develop viral meningitis.

What are the most common bugs causing viral meningitis?
Viral meningitis can be caused by many different viruses. The most common cause is an enterovirus infection (either an echovirus or coxsackie virus).

Less commonly reported (or very rare nowadays) viruses include the following; poliovirus, mumps virus, herpes simplex type 2 virus, herpes zoster, influenza types A or B, arbovirus, rubella, Epstein Barr virus.

How is viral meningitis diagnosed?
Viral meningitis is usually diagnosed following laboratory tests on the fluid surrounding the brain (cerebrospinal fluid, also known as CSF), by detection of virus in the stool of the patient, from throat swabs or blood samples.

How can I protect myself from infection?
The most important protection against the viruses that cause viral meningitis is hand washing to protect against the enteroviruses:

- You should wash your hands with soap and water after any contact with someone who has viral meningitis or a similar illness.
- You should also wash your hands after using the toilet and before preparing or eating food.
- Because babies frequently carry the viruses that cause viral meningitis it is particularly important to wash your hands after changing or handling dirty nappies.
- Viral meningitis is mainly seen in children so it is important to encourage your children to wash their hands after using the toilet, before eating or if they are in contact with someone who is ill.
- Vaccination against mumps, rubella and polio will protect you against these diseases.

For further information on viral meningitis please see http://www.hpsc.ie/A-Z/Respiratory/ViralMeningitis/

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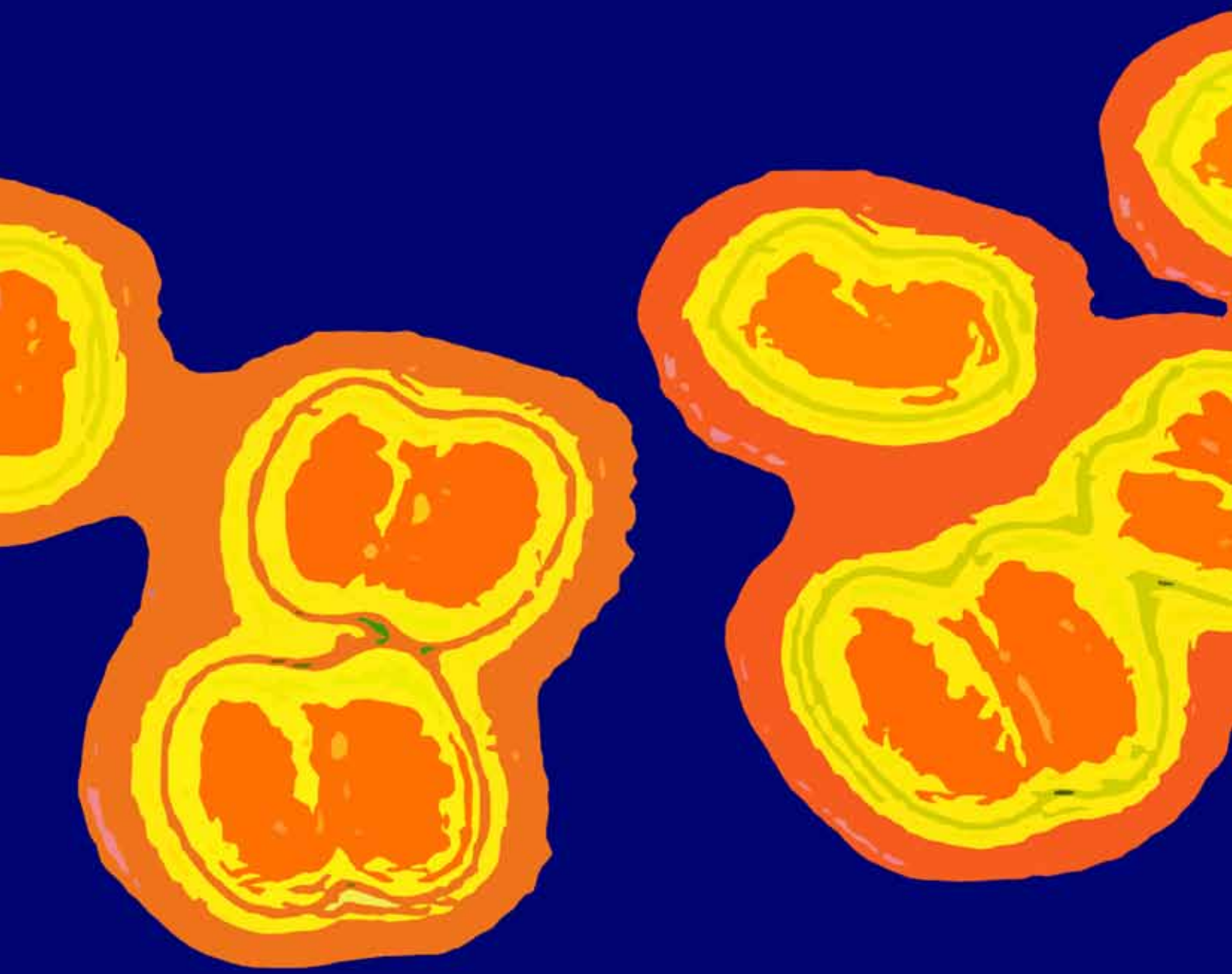

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