NATIONAL CLINICAL EFFECTIVENESS COMMITTEE

Tús Áite do Shábháilteacht Othar
Patient Safety First

Management of an Acute Asthma Attack in Adults (aged 16 years and older)

National Clinical Guideline No. 14

An Roinn Sláinte
DEPARTMENT OF HEALTH

November 2015

Guideline Development Group
The National Clinical Guideline on Management of an Acute Asthma Attack in Adults was developed by a sub-group of the National Clinical Programme for Asthma (NCPA). The Guideline Development Group was chaired by Professor Pat Manning.

Using this National Clinical Guideline
The aim of this guideline is to assist health care professionals in all healthcare settings, (pre-hospital emergency care, primary care and secondary care including Emergency Department/ Acute Medical Unit and specialist services including maternity, mental health, disability and specialised orthopaedic centres) in assessing and making decisions on the management of acute asthma in adults and to assist policy makers and those planning acute services for adult asthma patients.

The National Clinical Programmes including the National Clinical Programme for Asthma (NPCA) were set up through the HSE's Clinical Strategy and Programmes Division with the aim of delivering better care and outcomes through the best use of resources, delivered through standardised care pathways and models of care for the patient journey throughout the national health system. The Programmes are focused on transforming the way care is delivered in Ireland, with the overarching aim of improving the quality and safety of patient care. The National Clinical Programmes have a direct impact on the patient experience and are improving care in a number of ways through defining the patient journey and this includes the development and dissemination of clinical evidenced-based guidelines to standardise and improve treatment. The development and dissemination of this Guideline on the Management of an Acute Asthma Attack in Adults is in line with this policy. This guideline provides recommendations based on current evidence for best practice in the management of an asthma attack in adults including pregnant women.

This National Clinical Guideline is available at:
www.health.gov.ie/patient-safety/ncec and www.hse.ie/asthma

Reference of National Clinical Guideline
National Clinical Guideline No. 14 should be referenced as follows:
Department of Health – Management of an Acute Asthma Attack in Adults
National Clinical Guideline No. 14.
November 2015. ISSN 2009-6259.

Disclaimer
This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available. It is advised, however, that significant departures from the national guideline should be fully documented in the patient's case notes at the time the relevant decision is taken.

National Clinical Effectiveness Committee (NCEC)

The National Clinical Effectiveness Committee (NCEC) was established as part of the Patient Safety First Initiative. The NCEC is a partnership between key stakeholders in patient safety. NCEC's mission is to provide a framework for national endorsement of clinical guidelines and audit to optimise patient and service user care. The NCEC has a remit to establish and implement processes for the prioritisation and quality assurance of clinical guidelines and clinical audit so as to recommend them to the Minister for Health to become part of a suite of National Clinical Guidelines and National Clinical Audit.

The aim of the suite of National Clinical Guidelines is to provide guidance and standards for improving the quality, safety and cost-effectiveness of healthcare in Ireland. The implementation of these National Clinical Guidelines will support the provision of evidence-based and consistent care across Irish healthcare services.

NCEC Terms of Reference

1. Provide strategic leadership for the national clinical effectiveness agenda.
2. Contribute to national patient safety and quality improvement agendas.
3. Publish standards for clinical practice guidance.
4. Publish guidance for National Clinical Guidelines and National Clinical Audit.
5. Prioritise and quality assure National Clinical Guidelines and National Clinical Audit.
6. Commission National Clinical Guidelines and National Clinical Audit.
7. Align National Clinical Guidelines and National Clinical Audit with implementation levers.
8. Report periodically on the implementation and impact of National Clinical Guidelines and the performance of National Clinical Audit.
9. Establish sub-committees for NCEC work streams.
10. Publish an Annual Report.

Information on the NCEC and endorsed National Clinical Guidelines is available at:
www.health.gov.ie/patient-safety/ncec

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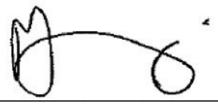

Prof Pat Manning
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Table of Contents

List of tables

List of figures

1 Background

1.1 Need for a National Clinical Guideline

There are no grounds for complacency regarding asthma in the Republic of Ireland, as we have one of the highest rates of asthma prevalence in the world (1, 2). It is a chronic medical condition, which for many patients, begins in childhood, and is thus life-long. A great number of patients live and work without being free of regular asthma symptoms, due primarily to having uncontrolled disease (3), even despite the availability of well-constructed international evidenced-based guidelines and excellent, accessible and safe medicines. Uncontrolled asthma leads to poor quality of life for many of these patients as well as their families and caregivers. It is a condition often associated with increased cost due to out of hours GP visits, emergency department visits, and hospitalisation for acute asthma attacks as well as the associated loss of time from work and school (4).

The National Clinical Programme for Asthma (NCPA) was set up to design and standardise the delivery of high quality asthma care to all who need it. The NCPA also focuses on improving asthma control in the community, reducing acute asthma attendances at emergency departments, in-patient admissions and needless deaths from asthma. A specific priority solution to help manage patients with acute asthma attacks has been the development of this national evidence based guideline by the NCPA.

1.2 Clinical and financial impact of acute asthma

1.2.1 Budget impact of the proposed guideline

This guideline provides clear guidance for the assessment and treatment of acute asthma in general practice, by paramedic services, the Emergency Department (ED) and in the acute hospital for adults. The estimated annual cost of care for acute asthma attacks in the Republic of Ireland is of the order of €6.5 million and much of this cost relates to adult admissions (see Appendix 17). Hospitalisation accounts for between 20 and 25% of the overall cost (5). International research has identified that the majority of hospital admissions for asthma are emergency admissions of which 70% may have been preventable with appropriate early intervention (6, 7). An acute attack requiring hospital attention at the Emergency Department (ED) or in-patient care represents a serious failure of asthma control. In that situation, patients will need to have access to local, easily accessible and competent services in an emergency, which may be their GP practice, GP out-of-hours/urgent care services (GPOOH), ED or in-hospital care. About 15% of patients relapse following an asthma attack (8), especially if seen in an ED.

Patients with an acute attack of asthma are at increased risk of death and readmission for asthma if not managed appropriately (8). Patients who attend GPOOH, ED and those who are admitted to hospital for acute asthma should be followed up by attending their GP within 2 working days of discharge for ongoing asthma management. International best practice (8) recommends that all patients admitted to hospital should be followed up on discharge from hospital in a medical specialist clinic for 1 year (in conjunction with their GP) until stable.

The cost impact analysis focuses on two costing areas. This is detailed in Appendix 17.

Staff training:
The main costs for guideline implementation are the costs associated with structured training for clinical staff in hospital and GPOOH settings on acute asthma guideline managed care. It is critical that medical staff involved with acute asthma patients have the knowledge and training

to manage these patients appropriately. It is estimated that the overall cost of training relevant HSE staff would be €193,104, but these costs are mostly opportunity costs.

Possible additional cost implications arising from implementing the guidelines:
Additional costs that have been reviewed but are essentially either cost neutral or are associated with the implementation of an overall Asthma Model of Care Chronic Disease Management Programme for primary care linked to specialist care include the following:

- Recommendation that a spacer device is used with a pressurised multidose inhaler (*p*MDI) inhaler in mild-moderate asthma attacks rather than wet nebulisation for salbutamol bronchodilation where possible
- Recommendations on medications e.g. inhaled steroids and oral steroids in acute asthma attacks
- Recommendation of follow up with a GP within 2 working days of discharge from ED
- Recommendations on follow up in the medical specialist/nurse led OPD clinic for 1 year for patients admitted to hospital with acute asthma following discharge
- Recommendation that all patients have a peak flow meter reading on assessment by paramedic and on admission to GPOOH, ED and Hospital.

In relation to the above, it is estimated that there are possible annual savings of €179,978 from reducing the use of nebulisers in the ED. Additionally, better management by specialist/asthma nurse led clinics following discharge, leading to non-attendances at ED and GPOOH and reduced admissions by 20%, could result in estimated annual savings of €1,380,000.

1.2.2 The implications for service development in guideline implementation

The implementation of the guideline will have implications for service development, such as:

- All HSE staff involved with patients experiencing an asthma attack should have appropriate training in arranging rapid assessment for asthma, in all healthcare settings in which patients may attend in an emergency.
- Pre-hospital emergency care practitioners may be the first health care professionals that people will encounter in an emergency. They need to have the right skills and training to provide support before they can reach more specialist treatment. They also need to be able to distinguish between people who need hospitalisation and those who could safely be redirected to community services.
- GP Out–of-hours (GPOOH) centres are increasingly the first port of call for people experiencing an asthma attack. Therefore medical/nursing staff in these settings need to be as well-trained as in all other settings and in particular need to have close communication with primary care to ensure prompt and appropriate follow-up after the episode. It is particularly important that out-of-hours services are aware of the people at greatest risk of having an attack and are knowledgeable and competent in dealing with asthma attacks.
- Hospital staff, including Emergency Department and in-patient hospital personnel involved in triage, assessment and management of acute asthma should have the appropriate knowledge and training in acute asthma assessment and ongoing care for this condition.
- There is over-use of nebulisers in acute situations. Delivery of short acting bronchodilators by nebuliser instead of by standard inhaler with a spacer can encourage a reliance on hospital care, and lead to repeat hospital attendances by patients, when delivery using an inhaler and spacer may be adequate. This guideline recommends that Hospital Emergency Departments, GPOOH and urgent care centres do not use nebulisers routinely for treatment of acute attacks, except where appropriate.
- Patients who are admitted to hospital should be managed in a ward where staff including nurses, have adequate training and experience in monitoring acutely ill, asthma patients and are proficient at administering appropriate medications for this.
- Every acute hospital admissions unit should have a senior clinical individual who is responsible for ensuring that asthma care across all departments conforms to the Management of an

Acute Asthma Attack in Adults guideline, and to ensure that records and audit processes and outcomes are identified and stored.

- Implementation of bundles of care for acute asthma care to encourage adherence to best practice guidelines is recommended locally.

1.3 Overview of epidemiology of asthma

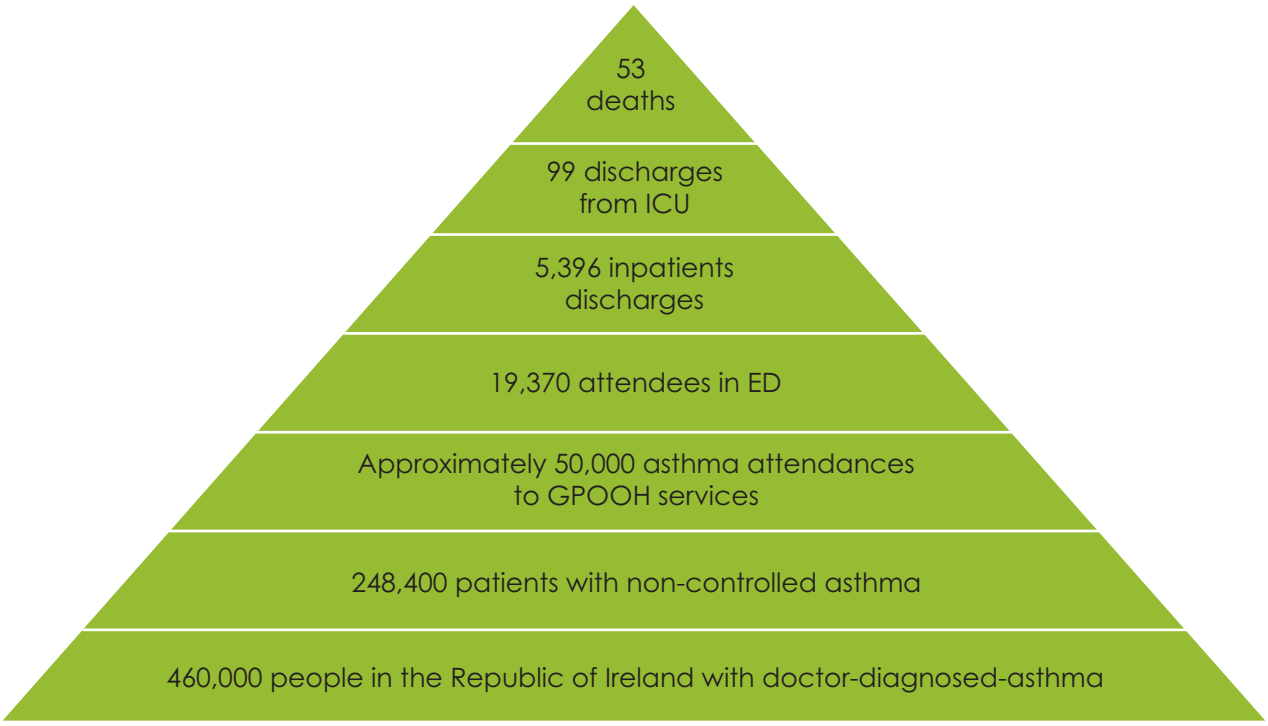


Figure 1 Asthma Epidemiology – based on 2011 data

1.3.1 Current levels of asthma in Ireland

Asthma is a high prevalence disease in the Republic of Ireland with nearly 460,000 people estimated to have been diagnosed with asthma and nearly a quarter of a million may have asthma that is not controlled (2). About 50,000 patients are estimated to use the GP out-of-hours service for the treatment of acute asthma in a year. Over 19,000 people visit Emergency Departments annually with acute asthma and over 5,000 patients are admitted to hospital (9). Of these about 100 are so severely ill that they are admitted to an intensive care unit.

1.3.2 Asthma deaths

About one person dies from Asthma every week in Ireland (9).

Confidential enquiries into asthma deaths or near fatal asthma attacks from the UK and Ireland have identified a number of factors which contribute to an asthma death. Most deaths from asthma occur before admission to hospital, and usually occur in patients who have chronic asthma, who are on inadequate inhaled corticosteroid therapy with increased reliance on inhaled ß2-agonists (10). There is generally poor perception by the patient or physician caring for the patient of the overall severity of the asthma attack. In addition, inadequate management in the acute event including using sedation in some cases are also factors linked to asthma deaths. Deaths from asthma, while uncommon, are generally preventable and occur usually

in association with an acute attack. Although most of these patients have chronically severe asthma, in a minority the fatal attack has occurred suddenly in a patient with mild or moderately severe background disease. Most asthma deaths occur before admission to hospital. Many deaths occur due to patients receiving inadequate treatment with inhaled steroids or steroid tablets and/or inadequate objective monitoring of their asthma, where follow up was inadequate in some and others should have been referred earlier for specialist advice (10).

1.4 Aim of National Clinical Guideline

The aim of the National Clinical Guideline is to assist health care professionals in all healthcare settings, (pre-hospital emergency care, primary care and secondary care including ED/AMU and specialist services including maternity, mental health, disability and specialised orthopaedic centres) in assessing and making decisions on the management of acute asthma in adults by outlining evidence based threatment protocols. It also aims to assist policy makers and those planning acute services for adult asthma patients.

The expected benefits resulting from the implementation of this guideline include:

- A reduction in asthma related deaths in adults
- Improved patient experience, safety and quality of care
- Raised levels of awareness among healthcare professionals on how to manage acute asthma attacks in adults, including pregnant women
- Improved efficiency in the admission, care, discharge and follow-up of adults experiencing an acute asthma attack

1.5 Scope of National Clinical Guideline, target population and target audience

These guidelines are for the management of acute adult asthma attack in all care settings including primary and secondary care and specialist centres. The guideline considers all adult patients (>16 years) with a diagnosis of asthma.

This guideline does not cover patients whose primary respiratory diagnosis is not asthma, for example those with chronic obstructive pulmonary disease (COPD) or cystic fibrosis (CF), although these patients may also have asthma and the principals outlined in these guidelines may also apply to the management of their asthma component symptoms.

The scope of the recommendations set out in this document does not extend to children or youth populations, or difficult/severe but stable asthma. Nor do the recommendations relate to specific settings, such as primary care, and/or populations, such as pregnant women, unless the recommendations refer to the management of an acute asthma attack in such settings/ populations.

There are separate **Acute Paediatric Asthma Guidelines** which have been developed by the National Clinical Programme for Asthma.

The recommendations set out in this National Clinical Guideline seek to address the following clinical questions:

Table 1 Clinical questions

What is best practice management of patients with an acute asthma attack in primary care?
What are the criteria for referral to the Emergency Department for a patient with an acute asthma attack?
What are the hospital admission criteria with an acute asthma attack?
What are the signs to distinguish the severity of an asthma attack?
What are the key components of an objective assessment of an attack in the adult asthma patient?
What is the best practice treatment of the adult asthma patient during an acute attack?
What is best practice management of an acute asthma attack in pregnancy?
What discharge and follow-up planning is required for patients with an acute asthma attack?
What role can patient education play in asthma management following an acute attack?
What should the follow up process be after an attack?

1.6 Governance

Governance of the guideline development process was provided by a multidisciplinary Guideline Development Group (GDG) which was chaired by the Clinical Lead for the National Clinical Programme for Asthma.

The GDG was responsible for the development and delivery of this National Clinical Guideline and included representatives from relevant medical groups with expertise in the diagnosis, treatment and care of patients with asthma.

Consultation, review and input to the guideline was sought from the Royal College of Physicians of Ireland Clinical Advisory Group (for the NCPA) nominated by the Irish Thoracic Society, other National Clinical Programmes and patient organisations.

The Clinical Advisory Group for the NCPA also had an oversight role.

The evidence base for this guideline is built on existing international guidelines which have been adapted to reflect care in an Irish healthcare setting. The main evidence utilised in this guideline is that from the Scottish Intercollegiate Guideline Network/British Thoracic Society – British Guideline on the management of asthma, 2014 and the Global Initiative for Asthma (GINA), updated 2015.

Permissions were sought and kindly granted from the Scottish Intercollegiate Guidelines Network (SIGN) and Global Initiative for Asthma (GINA) for use of their guidelines in the development of these guidelines.

1.6.1 Conflict of interest statement

Professor Pat Manning, National Clinical Programme Lead and Chair of the GDG, is a member of the GINA International Assembly as the Irish representative. Prof Manning's role is advisory and non-remunerated or supported and does not involve reviewing or making recommendations on the guidelines content; this is the role of Scientific Committee and Board. The GINA Assembly, are international asthma experts from many countries who meet twice a year with members of

the GINA Board (at the American Thoracic Society and European Respiratory Society Annual Conferences) to share information about upcoming changes to recommendations on asthma management, also issues of education, prevention and strategies for local dissemination of the GINA management programme. Prof. Manning has also been involved in the implementation of the GINA asthma management guideline in conjunction with the Irish College of General Practitioners and the Asthma Society of Ireland, which is regularly updated.

No conflicts of interest were declared by the GDG members.

1.6.2 Sources of funding

No external funding was requested or received in developing these guidelines however the NCEC funded the undertaking of the literature review and budget impact assessment.

1.7 Methodology and literature review

A systematic evidence review of literature was undertaken in formulating this guideline. A research team from the Dublin City University (DCU) School of Nursing and Human Sciences, led by Dr Veronica Lambert, was commissioned by the National Clinical Effectiveness Committee (Department of Health) to carry out the review.

1.7.1 Background

The goal of the review was to support the decision to develop a National Clinical Guideline (NCG) for the Management of an Acute Asthma Attack in Adults. This NCG was to support the Model of Care for the HSE National Clinical Programme for Asthma in Ireland, and be quality assured by the National Clinical Effectiveness Committee (NCEC). The aim of Dr Lambert and her team was to deliver a systematic review of clinical guidelines used in primary and secondary care contexts. This includes general practice, paramedic services, emergency departments and acute adult hospital contexts, for the assessment and management of the acute adult asthma patient to improve clinical outcomes (including reduction of morbidity and mortality) and quality of life for adults living with asthma in Ireland.

1.7.2 Objectives

The purpose of the review was to complete a systematic search for and review of guidelines to support the adaptation of recommendations for the Irish National Clinical Guideline for the Management of an Acute Asthma Attack in Adults.

The following three objectives were addressed;

1. Identification of developed evidence based clinical guidelines related to the management of acute asthma for adult patients through the conduct of a systematic search over a specified period (2011-2015) in line with the ADAPTE process (11)
2. Co-ordination of a quality assessment of the retrieved clinical guidelines using the AGREE II tool (12)
3. Analysis of the recommendations of the retrieved clinical guidelines and their applicability to the decisions for inclusion of the recommendations in the Irish National Clinical Guideline for the management of acute asthma attacks in adult patients

These objectives were confirmed with the HSE Asthma Guideline Development Group (GDG) and DoH Clinical Effectiveness Unit (CEU) through the nominated contact points prior to the commencement of the review.

1.7.3 Method

The methodology for this review followed the ADAPTE process as outlined in the Guideline Adaptation Resource Toolkit (The ADAPTE Collaboration 2009) (11) and the National Clinical Effectiveness Committee (NCEC) Guideline Development Manual of 2013 (13) with regard to considering clinical guideline evidence for the review; search methods; guideline selection and assessment and decisions around adaptation of guideline recommendations. Assessment of guideline quality was guided by the AGREE II (Appraisal of Guidelines for Research and Evaluation) Instrument (Brouwers et al. 2010) (12).

The work plan for this systematic guideline review was structured around 3 work strands;

Strand 1 involved systematically searching over a specified period (2011-2015) various literature sources in line with the ADAPTE process to identify guidelines related to the management of acute asthma in adults.

Strand 2 involved coordinating the quality assessment among 4 appraisers (3 from DCU and 1 from the GDG) of the retrieved guidelines using the AGREE II tool.

Strand 3 involved an analysis of the retrieved guidelines recommendations to evaluate their applicability to the decisions for inclusion in the Irish National Clinical Guideline.

1.7.4 Strand 1: Systematically searching, retrieving and screening clinical guidelines

In line with steps 8, 9 and 10 of the ADAPTE process this strand involved 3 main steps; developing criteria for considering evidence for inclusion in the review; searching for guidelines and other relevant documents; and screening retrieved guidelines to determine eligibility for inclusion in the review.

Criteria for considering evidence for inclusion in the review
The PICOS parameters guiding the review search strategy were;

- **Population:** Adult patients >16 years with acute **attack** of asthma
- **Intervention:** Effectiveness of interventions designed to manage acute **attacks** of asthma in adult patients >16 years
- **Comparison:** Primary and secondary care (including general practice, paramedic services, emergency departments and acute adult hospital contexts)
- **Outcome:** Most clinically effective interventions for managing acute **attacks** of asthma in adult patients >16 years

For the S (i.e. study design) of the PICOS clinical practice guideline (CPG) was specified.

The following inclusion and exclusion criteria were used to assist in the search and retrieval of guidelines (Table 2).

Table 2 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Evidence-based guidelines only (guidelines must include a report on systematic literature and explicit links between individual recommendations and their supporting evidence)	Guidelines written by a single author not on behalf of an organisation (for validity a guideline needs multidisciplinary input)
National and/or international guidelines only	Guidelines published without references (it is necessary to know that the guidelines and recommendations were based on best, current evidence)
Peer reviewed publications only	
Written in the English language	

To minimise bias in the review process, the PICOs and inclusion/exclusion criteria were finalised *a priori* and agreed with the Steering Committee prior to the commencement of the review.

Search methods for identifying clinical practice guidelines for the review
Drawing on step 8 and the search sources mapped in tool 2 of the ADAPTE process a variety of sources to retrieve clinical practice guidelines for the management of acute asthma in adults were searched, including; guideline clearinghouses; websites of organisations which specifically develop guidelines and/or support evidence based practice; any relevant specialty societies (i.e. asthmatic, thoracic and lung associations); electronic databases; review databases; internet search engines; grey literature databases and citation searching retrospectively. These are outlined below.

Search strategy
The search strategy comprised of three stages. Stage 1 used a limited set of key words to search a small number of guideline clearinghouses and organisational websites to identify potentially relevant clinical guidelines (e.g. "asthma management guidelines"; "acute asthma treatment recommendations") related to adult asthma management. Similarly a limited set of free text key words were used to search the database MEDLINE to identify potentially relevant clinical guidelines related to adult asthma management. A brief review of the retrieved guidelines was conducted in an effort to expand key words and phrases for a more in-depth search. Prior to progressing the second search strategy stage, finalised search terms with the nominated contact points for the HSE Asthma Guideline Development Group (GDG) and DoH CEU were agreed. Stage 2 repeated stage 1 searches and expanded these searches to other guideline resources (i.e. guideline clearinghouses and grey literature) and other databases (i.e. PUBMED, CINAHL, Cochrane) using the full list of key words (both free text and the databases controlled vocabulary e.g. MeSH, Subject Headings etc.) developed in Stage 1. Stage 3 of the search entailed searching the reference lists of retrieved eligible guidelines. All searches were conducted and outputs cross-checked by at least 2 or more members of the review team.

Search sources
The following electronic guideline clearinghouses were searched using various key words specific to adult acute asthma management and clinical practice guidelines; United States National Guideline Clearinghouse and Guidelines International Network. See Appendix 3.

The following organisations which develop guidelines and/or support evidence based practice were also searched; the Scottish Intercollegiate Guidelines Network; the National Institute for Health and Clinical Excellence; the New Zealand Guideline Group; the Centre for Clinical

Effectiveness Australia; the National Health and Medical Research Council (Australia); the Clinical Practice Guideline Portal and the TRIP database. See Appendix 3.

A cross-section of international ***asthma, thoracic and lung associations*** were searched, including; Asthma UK; British Society for Allergy and Clinical Immunology; British Lung Foundation; Asthma Society of Ireland; American Academy of Allergy Asthma and Immunology; Asthma and Allergy Foundation of America; National Heart, Lung and Blood Institute; National Institute of Allergy and Infectious Diseases; Association of Asthma Educators; Centres for Disease Control and Prevention; National Asthma Education and Prevention Program; Canadian Society of Respiratory Therapists; Asthma Society of Canada; Allergy and Asthma Information Association; European Federation of Asthma and Allergy Associations; European Academy of Allergy and Clinical Immunology; European Lung Foundation; European Respiratory Society; Asthma New Zealand; The Asthma Foundation; Asthma Australia; National Asthma Council Australia; Australia Medical Association; GINA - Global Information Network on Asthma; World Allergy Organization; World Health Organisation; International Primary Care Respiratory Group; Global Allergy and Asthma Patient Platform; Allergic Rhinitis and it Impact on Asthma; Global Alliance against Chronic Respiratory Disease; British Thoracic Society; American Thoracic Society; Canadian Thoracic Society/ Respiratory Guidelines; Irish Thoracic Society; Scottish Thoracic Society; the Thoracic Society of Australia and New Zealand; the Lung Association Ontario; American Lung Association and the Lung Association. See Appendix 3.

Other specific ***grey literature*** sites searched were the Agency for Healthcare Research and Quality and Open Grey. See Appendix 3.

The ***electronic databases*** of PubMed, MEDLINE, CINAHL and ***review databases*** of Cochrane (inclusive of Cochrane Database of Systematic Review; Database of Abstracts of Review Effects) and NHS Centre for Reviews and Dissemination were searched using various combinations of controlled vocabulary and free text words. See Appendix 3.

Finally, ***internet engines*** including **Google, Bing and Yahoo/AltaVista** were searched using key search terms focused on acute asthma management in adults. If available, these searches were all narrowed to the English language and limited to the file type pdf. As large volumes of data return through search engine searches, screening was managed by screening the first 10 pages (i.e. 100 pdf files on each internet search engine). These internet searches were completed after all other searches and essentially any guidelines that had not already retrieved from other sources were looked for. See Appendix 3.

Screening retrieved guidelines

Retrieved guidelines that met the review objectives and inclusion criteria were screened and selected for further appraisal. This involved 2 or more reviewers independently assessing the full-text guideline documents against the review objectives and inclusion criteria before a final decision regarding inclusion/exclusion was confirmed. Any discrepancies were resolved by discussion with a further review author. Clinical guidelines excluded from the review were recorded; noting reasons for exclusion. A full audit trail of all the screening processes was maintained and an adapted PRISMA flow chart was used to visually report the screening and selection process (Figure 2). For retrieved guidelines, 2 reviewers independently extracted details on the developing organisation/authors; date of publication, country/language of publication; dates of the search used by the source guideline developers using the table for *recording the characteristics of the retrieved guidelines* as recommended in ADAPTE (see Appendix 4).

Search outputs

The final outputs of the search strategies and screening for eligibility for inclusion in the review are outlined in Figure 2 below. A total of 2,967 potentially eligible documents were retrieved for screening across all data sources. After stage 1 screening, 2,915 documents were excluded because they were not specific to asthma; not systematic evidence based guidelines; not

national/international guidelines; not adult populations; published before 2011 and/or were duplicates. Thus, 53 documents were identified as potentially eligible for inclusion. Following second screening a further 49 documents were excluded because they were either duplicates, not a clinical practice guideline; not a national/international guideline; they were based on other guidelines such as BTS/SIGN (8) or GINA (14) and/or they had no/limited reporting on methodology in terms of how guidelines were developed and/or grading of evidence. A total of 4 clinical practice guidelines were retrieved and deemed potentially eligible for inclusion in the review; including SIGN 141 British guideline on the management of asthma (British Thoracic Society and Scottish Intercollegiate Guidelines Network – BTS/SIGN updated 2015)(8); the Global Strategy for Asthma Management and Prevention (Global Initiative for Asthma - GINA updated 2015) (14); the Consensus Statement for the diagnosis and management of asthma from the Canadian Thoracic Society (updated 2012) (15) and the Australian Asthma Handbook from the National Asthma Council Australia (updated 2015) (16).

Following discussion with the Asthma Guideline Development Group and further screening of these 4 potentially eligible clinical documents a decision was made to exclude the Consensus Statement for the diagnosis and management of asthma from the Canadian Thoracic Society (updated 2012)(15) and the Australian Asthma Handbook from the National Asthma Council Australia (updated 2015)(16). Reasons for exclusion were the lack of specific focus on the management of acute asthma and missing data to enable us to assess the guideline according to the review criteria. Therefore 2 clinical practice guidelines were left for inclusion in the review – the SIGN 141 British guideline on the management of asthma (British Thoracic Society and Scottish Intercollegiate Guidelines Network – BTS/SIGN updated 2015) (8) and the Global Strategy for Asthma Management and Prevention (Global Initiative for Asthma - GINA updated 2015) (14). The decision to include both of these guidelines in the review was strengthened by their currency; both guidelines had been updated in 2015. Secondary citation searching of both these guidelines was completed and no further clinical practice guidelines were identified for inclusion in the review.

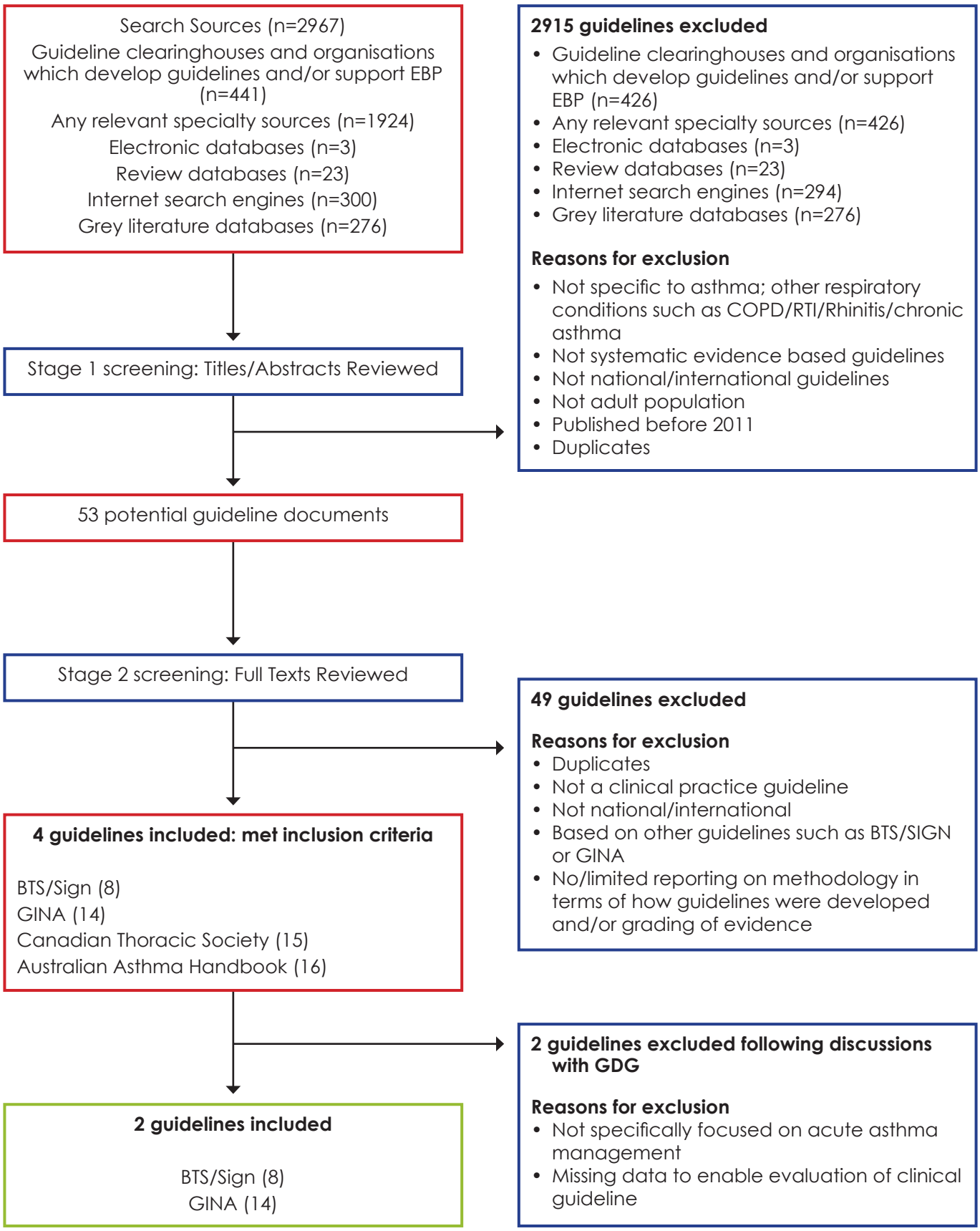


Figure 2 Flowchart of search outputs and screening

1.7.5 Strand 2: Assessment of guideline quality

In line with step 11 of the ADAPTE process, the quality of all guidelines deemed eligible for inclusion in the review were critically appraised by 4 appraisers using the domains of the Appraisal of Guidelines Research and Evaluation (AGREE II) Instrument (11) as follows; scope and purpose; stakeholder involvement; rigour of development; clarity of presentation; applicability; editorial independence and overall guideline assessment (Appendix 5). There were 2 phases to the assessment of guideline quality process; (i) a guideline appraisal training phase and (ii) a main appraisal phase. In phase (i), a protocol for the guideline appraisal process was drafted (Appendix 6) and a group appraisal was set up via the MY AGREE PLUS (Appendix 7); which assisted with the individual completion and coordination of the group appraisal results online. All 4 appraisers individually scored the 'training guideline' (i.e. BTS/SIGN (8)).

For phase (ii) each appraisal member was given access to the second guideline eligible for inclusion in the review (i.e. GINA) and a second online group appraisal was set up via the MY AGREE PLUS online tool. All 4 appraisers individually scored the GINA guideline (14). Once completed the scores of all the completed AGREE II Instruments were calculated on MY AGREE PLUS, entered into a spreadsheet and transferred into a graphical format to enable ease of comparison of guidelines appraisals across the various quality assessment domains in terms of overall scores and inter-rater agreement (Appendix 9). Following both phases (i and ii), the appraisal review team met, in conjunction with the DoH CEU, to discuss the results and any discrepancies in ratings (especially for ratings > score of 1 difference) were resolved through discussion. Across both the BTS/SIGN (8) and GINA (14) guidelines, the main domains where some differences in ratings existed were domain 2 stakeholder involvement (item 4, 5); domain 3 rigour of development (items 8, 10, 11, 13), domain 5 applicability (items 18, 19, 20, 21) and domain 6 (items 22, 23). Most discrepancies were the result of different interpretations of the rating criteria and considerations and/or data not been sourced, which were easily resolved through discussion among the 4 appraisers with the CEU acting as arbitrator if required. Following these discussions, the group appraisals were revised (Appendix 9) and an overall group consensus appraisal score was calculated as presented in Appendix 10.

Figure 3 below illustrates the overall group consensus ratings for all items across all domains for the BTS/SIGN (8) guideline. It was agreed that 19 of the 23 items achieved a maximum rating of 7; the exceptions were items 5, 18, 19, and 20. Item 5 falls under domain 2 stakeholder involvement and relates specifically to the views and preferences of the target population. While there was evidence of this within the BTS/SIGN guideline (8) the explicit process and methods used to gather patient/public views was not outlined, and/or what and how the information gathered was used to inform the guideline development process and the recommendations; therefore a rating of 6 was agreed to take account of this missing information. Items 18, 19 and 20 all belong to domain 5 which relates specifically to applicability - how the guidelines might be implemented in practice including facilitators and barriers; tools to facilitate application; and resource and cost implications. There was limited information on all these items in the BTS/SIGN guideline (8) and/or supporting documents and thus ratings ranging from 4-5 were agreed for these items. Figure 4 below illustrates the overall group consensus ratings for all items across all domains for the GINA (14) guideline. It was agreed that 10 of the 23 items achieved a maximum rating of 7; the exceptions were items 2, 3, 4, 5, 6, 8, 9, 10, 13, 17, 18, 20 and 21. Of these items 3, 4, 6, 8, 9, 10, 17 achieved a score of 6; meaning that the appraisal group felt that some specific criteria and/or considerations were not explicitly described within the GINA guideline (14) and/or supporting documents. Of the remaining items, similar to the BTS/SIGN guideline (8), the appraisal groups sought more specific information on how the views and preferences of the target population were sought and translated into the recommendations (item 5 with a rating of 4) and more details on the guideline implementation process, cost and auditing (items 18, 20 and 21 all related to the domain of applicability achieving ratings of 5, 4 and 4 respectively). The remaining items related to presenting explicit health questions (item 2 rated at 5) and detailing

the external review process (item 13 rated at 5); while these 2 items were reported the details were limited and did not meet all the criteria/considerations outlined in AGREE II.

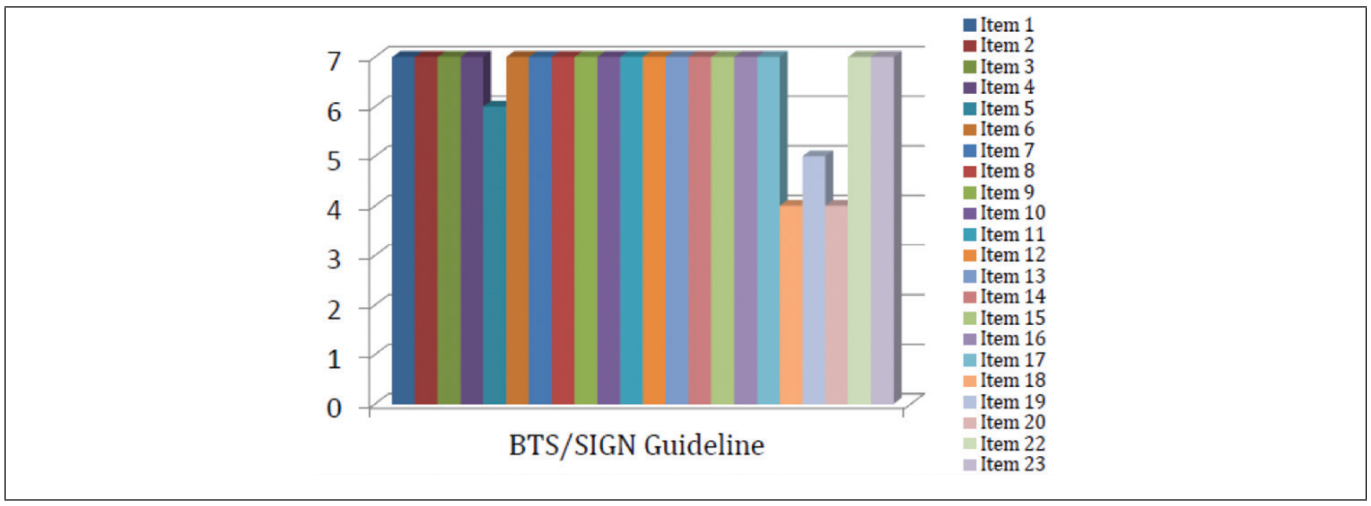


Figure 3 Group consensus appraisal scores for the BTS/SIGN Guideline

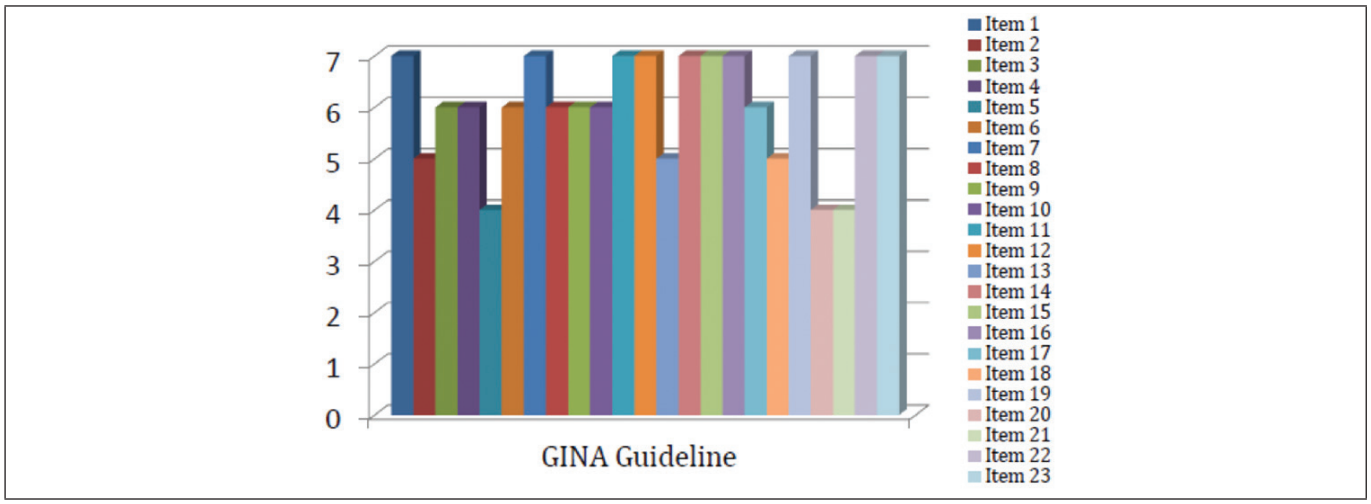


Figure 4 Group consensus appraisal scores for the GINA Guideline

Drawing on the AGREE II instrument the 6 domain scores are independent and should not be aggregated into a single quality score; rather a quality score is calculated for each of the 6 AGREE II domains. The appraisal group's consensual quality scores for each of the 6 AGREE II domains for both BTS/SIGN (8) and GINA (14) guidelines are displayed in Table 3 below. While these domain scores may be useful in comparing the guidelines the AGREE Consortium has not set minimum domain scores or patterns of scores across domains to differentiate between high and low quality but rather recommends that decisions are made by users and guided by the context in which AGREE II is used (12). On completing the 23 items of the AGREE II, 2 overall assessments of the guideline were made. One required the appraiser to make an overall judgement on the quality of the guideline and the other asked the appraiser whether he/she would recommend the guideline for use. The consensus of the guideline appraisal group was that they would recommend both BTS/SIGN (8) and GINA (14) for use and the overall judgement on the quality of both BTS/SIGN (8) and GINA (14) is presented in Figure 5 below where a rating of 1 represents 'lowest possible quality' whereas a rating of 7 represents 'highest possible quality'.

Table 3 Quality Score for each six AGREE II domains for both BTS/SIGN (8) and GINA (14)

Guideline/ Domain	Domain 1: Scope & Purpose	Domain 2: Stakeholder Involvement	Domain 3: Rigour of Development	Domain 4: Clarity of Presentation	Domain 5: Applicability	Domain 6: Editorial Independence
BTS/SIGN	21/21 **100%**	20/21 **95%**	56/56 **100%**	21/21 **100%**	17/28 **61%**	14/14 **100%**
GINA	18/21 **86%**	16/21 **76%**	51/56 **91%**	20/21 **95%**	20/28 **71%**	14/14 **100%**

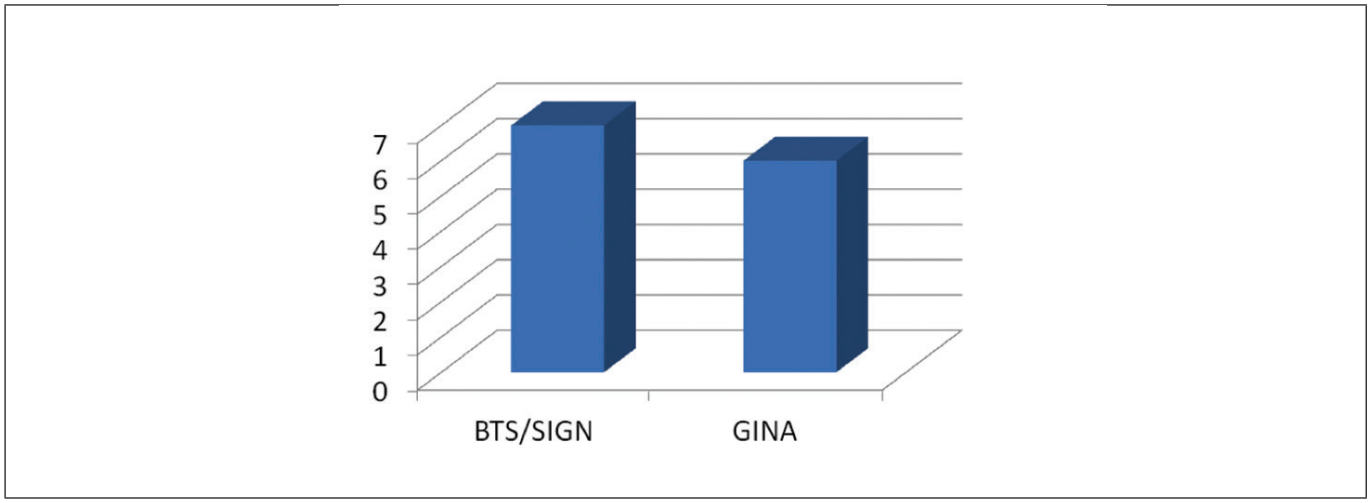


Figure 5 Rating of overall quality of the guideline

1.7.6 Strand 3: Analysis of guideline recommendations

For this strand steps 13, 14 and 15 of the ADAPTE process were drawn upon which included assessing the content and consistency of the guidelines, in addition to, the acceptability and applicability of the recommendations.

Assessing guideline content

Drawing on the example in the ADAPTE guidelines, a tabulated matrix to extract recommendations from the guidelines under review was designed. Data on the context/topic, key recommendation and grade of evidence was extracted. In relation to what context/topic and key recommendations to extract, this was guided by the overall review objective and the pre-determined PICO parameters. Thus, recommendation data was extracted that specifically referred to "acute" asthma management in adults. This resulted in the exclusion of a large proportion of recommendations from both guidelines which largely focused on the general principles of controlling, monitoring, treating (pharmacologically and non-pharmacologically) and reducing modifiable risks in the management of stable asthma. Content recommendations related to children or youth populations, difficult or severe but stable asthma, or recommendations related to specific setting such as primary care and/or populations such as pregnant women were not extracted unless explicit reference was made to management of "acute asthma exacerbations/asthma attack" in such settings/populations. This left a very definite set of extracted recommendations on the management of "acute asthma in adults" including referral for admission, pharmacological treatments for acute asthma in adults, investigations and monitoring, treating modifiable risks to reduce attacks, acute management in pregnancy, primary care, emergency departments and supporting self-management at time and following an acute exacerbation/asthma attack.

Only graded evidence based recommendations were extracted. It is worth noting that there were some subtle differences in the criteria descriptions that each guideline used in grading the recommendations and for ease of comparison these are presented in Appendix 11. A particular point to note when reviewing the extracted recommendations is that the BTS/SIGN guideline (8) refers to the levels of evidence as GRADES A-D, whereas the GINA guideline (14) uses the word EVIDENCE to distinguish levels of evidence A-D. Initially, recommendations for each guideline were extracted into two separate matrixes independently by one review team member – BTS/SIGN and GINA . These data extraction matrixes were then collated into one matrix combining the context/topic areas and recommendations from both guidelines (BTS/SIGN and GINA); however, apart from 'acute asthma management in pregnancy' there was limited overlap on the context/topic areas of the recommendations. All matrixes were cross-checked by a 2nd reviewer. Discrepancies were resolved by a 3rd reviewer and discussed with the Clinical Effectiveness Unit (CEU) and the Health Service Executive (HSE) Asthma Guideline Development Group (GDG). This included; discussions around the applicable recommendations to extract from the eligible guidelines i.e. recommendations had to be supported by graded evidence and recommendations had to be specifically related to '*acute asthma management in adults*'. Following discussions, the recommendation data extraction table was revised as presented in Appendix 12.

Assessing consistency between evidence, interpretation and recommendations
The assessment of consistency between evidence, interpretation and recommendations was conducted and cross-checked by 2 members of the review team with discrepancies resolved through discussion with a 3rd reviewer. To do this, firstly tool 13 from the ADAPTE process was used to evaluate the guideline search strategy and selection of evidence (i.e. relevance and exhaustiveness of databases searched, search strategies used, methods, criteria for selection of evidence, references etc.). Secondly, to evaluate the consistency between the selected evidence, its interpretation and resulting recommendation, access to evidence tables was sought. Where evidence was reported as weak or non-existent for a suggested recommendation explicit indication of the basis for the recommendation was sought (i.e. based on expert consensus). We drew on the ADAPTE process in relation to questions to ask in this evaluation (ADAPTE p. 31) and used the evaluation sheet for determining the scientific validity of guidelines (tool 14 ADAPTE).

The reviewer consensus ratings for Tool 13 (ADAPTE process) are presented in Appendix 13. Tool 13 evaluates the search and selection of evidence. There was agreement among the 2 reviewers that the overall search for evidence was comprehensive for both the BTS/SIGN (8) and GINA guideline (14). Tool 13 also evaluates reviewer's judgement on the bias in the selection of articles. For both the BTS/SIGN (8) and GINA (14) guideline, both reviewers found this difficult to assess but were in agreement in their rating of 'unsure'; this was as a consequence of limited reporting of the selection process in relation to the explicit number of references analysed, included, excluded and reasons for exclusion etc. While it was clear that explicit methodological processes were followed (17) in the selection and screening of evidence the actual outcomes were not reported explicitly in the guideline document to make adequate judgements on whether the overall bias in the selection of articles was avoided.

The reviewer consensus ratings for Tool 14 (ADAPTE process) are presented in Appendix 14. Tool 14 (ADAPTE process) evaluates 3 elements; whether the overall evidence is considered valid; whether the evidence and recommendations are coherent; and whether the scientific quality of the recommendations pose any risk of bias. For both the BTS/SIGN (8) and GINA (14) guideline, both reviewers agreed that the overall evidence was valid, the evidence presented throughout both guideline documents was mapped coherently to the recommendations and overall it was agreed the scientific quality of the recommendations of both the BTS/SIGN (8) and GINA (14) guidelines did not present risks of bias with the strength of the evidence attributed to each recommendation being adequately described, justified and clearly presented in both guidelines. Refer to Appendix 14.

Assessing acceptability and applicability of guideline recommendations
This phase was undertaken to determine the applicability of the guideline recommendations for inclusion in the Irish National Clinical Guideline for the Management of an Acute Asthma Attack in Adults. For acceptability and applicability the guideline recommendations were assessed by using the ADAPTE acceptability/applicability worksheet (tool 15) related to acute adult asthma management. This was conducted and cross-checked by 2 members of the review team with discrepancies resolved through discussion with a 3rd reviewer. The reviewer consensus ratings for Tool 15 (ADAPTE process) are presented in Appendix 15. Tool 15 evaluates whether the overall recommendations for the management of acute asthma in adults were acceptable and applicable. There was a general consensus among reviewers that all recommendations were acceptable and applicable for consideration in the Irish context by the Guideline Development Group.

1.7.7. Concluding summary

Using a systematic approach to searching, screening and appraisal, this review has identified a number of evidence based recommendations for the Guideline Development Group to consider in relation to the management of an acute asthma attack in adults. These recommendations were drawn from two guidelines BTS/SIGN (8) and GINA (14) and are outlined in Appendix 12. The total recommendations extracted from both guidelines were in excess of 50 and spanned all grades of evidence A-D including good practice points based on clinical experience/ panel consensus judgement; these are clearly highlighted in Appendix 12. The findings of this review should be viewed alongside the following limitations. The possibility that the search did not identify all relevant clinical guidelines cannot be excluded and inclusion of guidelines only in the English language may have introduced a degree of bias as a consequence of the exclusion of guidelines from different cultural contexts. These limitations were somewhat offset, however, by the use of explicit inclusion criteria, PICOs and a broad search strategy, inclusive of grey literature, guideline databases, guideline developer websites and a large cross-section of asthma, thoracic and lung associations. The fact that all searches and screening, conducted independently by at least 3 reviewers, consistently arrived at both the BTS/SIGN (8) and GINA (14) clinical guidelines increased our confidence that all relevant and current guidelines were identified for the review specified time period of 2011-2015. In relation to the appraisal process, the appraisal of both the BTS/SIGN (8) and GINA (14) guidelines was based solely on the "reporting" within the guidelines and thus might not accurately reflect the actual guideline development process; however, due to short timelines the authors/guideline developers were not contacted for additional clarification of unclear/missing information in relation to methodological processes. Arguably, this could also have accounted for lower scores for the applicability domain for both BTS/SIGN (8) and GINA (14) guideline quality appraisals as such information around planning, undertaking and evaluating implementation is more likely found outside the guideline document itself rendering the assessment of the applicability domain more challenging – this is something that has been highlighted recently in the literature (18). While the scoring of the AGREE II instrument can be a subjective process, the use of MY AGREE PLUS to coordinate the group quality appraisal assisted all four quality appraisal reviewers to independently appraise and comment on each appraisal item/domain before any group discussion to reach consensus was made thereby enhancing transparency in our audit trail and decision-making process. The consensus of the guideline appraisal group was that they would recommend both the BTS/SIGN (8) and GINA (14) guideline for use with an overall quality judgement rating of 7 and 6 attributed to the BTS/SIGN (8) and GINA (14) guideline respectively (where a rating of 1 represents 'lowest possible quality' whereas a rating of 7 represents 'highest possible quality').

1.8 Grading of recommendations

This evidence-based clinical practice guideline, based on the highest quality scientific evidence available, is a systemically developed statement containing recommendations for healthcare professions on the care of individuals with asthma. Guidelines are not intended to replace the healthcare professional's expertise or experience but are a tool to assist practitioners in their clinical decision-making process, with consideration for their patient's preferences.

To assist the reader of this guideline, the key to the grading of evidence and recommendations is as follows:

Levels of evidence	
1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1 -	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, eg case reports, case series
4	Expert opinion

Grades of recommendation	
Note: The grade of recommendation relates to the strength of the evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.	
A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+

Good practice points
√ Recommended best practice based on the clinical experience of the guideline development group

Grading of evidence and recommendations
Recommendations within this guideline are based on the best clinical evidence.

1.9 External review

The GDG sought the assistance of an International asthma advisor to review the draft guideline document - Prof. Mark Fitzgerald, *Professor of Medicine, Head, University of British Columbia and Vancouver General Hospital Divisions of Respiratory Medicine, Director, Centre for Lung Health, The Lung Centre, Vancouver, Canada and Chairman of Scientific Committee GINA*. Prof. Mark Fitzgerald was selected as an external reviewer due to his expertise in asthma care and for his broad international experience in asthma guideline development and guideline implementation in Canada.

This guideline was reviewed in draft form by Prof. Fitzgerald as an independent expert referee, who was asked to comment primarily on the comprehensiveness and accuracy of interpretation of the evidence base supporting the guideline and recommendations. Prof. Fitzgerald agreed with the guideline contents without significant changes. Prof. Fitzgerald's most recent declarations of interest are available on www.ginasthma.org.

1.10 Procedure for update of National Clinical Guideline

This guideline was published in November 2015 and will be reviewed in 3 years by the NCPA. Surveillance of the literature base will be carried out periodically by the NCPA so that the guideline will maintain its relevance and currency. Any updates to the guideline in the interim period or as a result of three year review will be subject to the NCEC approval process and noted in the guidelines section of the NCPA and NCEC websites.

1.11 Implementation of National Clinical Guideline

The implementation of the guideline will take multiple routes and will be a phased approach over a two to three year period.

All hospitals admitting asthma attacks should adopt this standard treatment protocol for the management of the asthma patient. The treatment care bundles, presented in Appendix 2, should be held in the patients chart. The care bundles are key to the evaluation and audit of asthma care process.

These protocols should be adopted by all hospitals who may deal with an asthma attacks in the course of other procedures, interventions, day surgery, admission, in-patient and out-patient visits.

A local implementation team with a local lead in each hospital site will facilitate implementation of the programme and these guidelines. This local lead will act as a champion for the programme. Whilst this group is not active in each site currently, the NCPA will untertake to engage with each site to support the establishment and ongoing activities of this group.

General Practitioners managing acute asthma attacks in primary care should adopt this standard treatment protocols and bundles for the management of the asthma patient.

1.11.1 Facilitation of implementation

To facilitate the implementation of the guideline, an asthma education programme has been developed and is available online (www.asthmasociety.ie and www.hse.ie). In addition a half day training workshop is provided by respiratory Clinical Nurse Specialists. The training workshop has recieved Category 1 approval from the Nursing and Midwifery Board of Ireland (NMBI). Medical/nursing training, undergraduate, post graduate and continuous professional development courses will be updated regularly in line with guidelines. Further training initiatives are underway in primary care for the implementation of national ICGP Quality in Practice Committee asthma guidelines.

The eLearning programme has been approved for CPD credits by ICGP.

The ICGP have developed additional online asthma modules to complement the NCPA programme. This is recommended for all primary care physicians and physicians-in-training.

1.11.2 Potential barriers to implementation

A barrier to implementation will be a lack of appropriate knowledge and training amongst heathcare professionals in the undertaking of an acute asthma assessment and in the provision of care. Healthcare professionals at every step of the patients' journey during an acute asthma attack should adhere to this guideline and register for relevant training (as set out in section 1.11.1 above) if required. The NCPA will work in collaboration with other key stakeholders to raise awareness and promote the use of this guideline.

It is well documented worldwide that patients with asthma have low expectations of disease management. They are frequently unaware of the GINA definition of well-controlled asthma and thus believe that daily wheezing/frequent need for short acting beta 2 agonist (SABA) is 'normal'. Thus, if patients' expectations of asthma management remain unchanged they will not be receptive to training on inhaler technique, education on medication adherence, use of an asthma action plan etc. This is one of the major barriers to implementation and needs to be addressed by all healthcare professionals. The introduction of the 'Under 6s' medical card in the GP under 6s contract in April 2015 is helping to address this issue as it includes an annual 'Cycle of Care' for Asthma assessment and chronic disease management which reflects significant elements of the Asthma Model of Care of the National Clinical Programme for Asthma. It is anticipated that a similar approach will be developed for older children and adults asthma in the near future.

1.12 Tools to assist the implementation of the National Clinical Guideline

A list of relevant tools to assist in the implementation of the National Clinical Guideline is available in Appendix 2.

1.13 Roles and responsibilities

1.13.1 Local hospital services

The CEO/General Manager, the Clinical Director and the Director of Nursing of the hospital have corporate responsibility for the implementation of this National Clinical Guideline and to ensure that all relevant staff are appropriately supported and trained to implement the guideline.

All clinical staff with responsibility for the care of patients with asthma are expected to:

- Comply with this National Clinical Guideline and any related procedures or protocols,
- Adhere to their code of conduct and professional scope of practice as appropriate to their role and responsibilities, and
- Maintain their competency for the management and treatment of patients with asthma.

1.13.2 Primary care services

Acute asthma care for each patient in primay care is generally the responsibility of the patient's GP, and when required, to link to the out of hours services in primary care (local on-call or the GPOOH services)and to the acute hospital ED services when appropriate.

The roles and responsibilities of all stakeholders involved in the lifecycle of the guideline are detailed in the table below (this is not an exhaustive list).

Table 4 Roles and responsibilities of stakeholders in relation to the National Clinical Guideline

Process	Applying	Auditing Use	Developing/ Updating	Reviewing
General Practitioners	✓			
Practice Nurses	✓			
Out of Hours Staff	✓			
Pharmacist				✓
Pre-Hospital emergency care practitioners	✓			
ED/AMU Physicians	✓			
ED/AMU Nursing Staff	✓			
Specialist Respiratory Teams	✓	✓	✓	✓
Clinical Audit Services		✓		✓
National Clinical Programme for Asthma		✓	✓	✓
Pre-Hospital Emergency Care Council		✓	✓	✓
Patient Organisation (Asthma Society of Ireland)				✓

1.14 Audit criteria

To ensure that this guideline positively impacts on patient care, it is important that implementation is audited. Audit is recommended to support continuous quality improvement in relation to the implementation of the National Clinical Guideline.

The following Key Performance Indicators will be used to evaluate the implementation of the guideline:

- Percentage of nurses in primary and secondary care who are trained by the National Asthma Programme
- Number of deaths caused by asthma annually

As the process of implementation continues the National Clinical Programme for Asthma will endeavour to expand the audit criteria.

At a local level, audit of the use of the treatment protocols will be carried out by Emergency/ Acute Medicine / Respiratory teams. The ED, AMU, Medical ward will retain a copy of the treatment bundle administered on file and make a copy available to assist them with audit. This will serve a dual function:

1) Notification of the patient to the Respiratory service for follow-up;
2) Audit of the treatment and education supplied to the patient prior to discharge.

1.15 Unlicensed medicines

It is important to recognise that the licensing process for drugs regulates the marketing activities of pharmaceutical companies, and not prescribing practice. Unlicensed use of drugs by prescribers is often appropriate and guided by clinical judgement. This practice is safeguarded in legislation in accordance with Medicinal Products (Control of Placing in the Market) Regulations 2007 (S.I. 540/2007) as amended. Furthermore, drugs prescribed outside license can be dispensed by pharmacists and administered by nurses or midwives.

This note should be read alongside Recommendations 16 and 18 and their preceding texts.

2 National Clinical Guideline recommendations

2.1 Summary of national recommendations.

The CEO/General Manager, the Clinical Director and the Director of Nursing of the hospital have corporate responsibility for the implementation of the recommendations in this National Clinical Guideline. Each member of the multidisciplinary team is responsible for the implementation of the individual guideline recommendations relevant to their discipline.

Risk Factors for Developing Fatal Asthma	
Grade	**Recommendation**
B	1. Healthcare professionals must be aware that patients who present with a severe asthma attack and one or more adverse psychosocial factors are at risk of death.
Management of Acute Asthma In Adults	
	Hospital Referral/Admission
B	2. Clinicians in primary and secondary care should treat asthma **attacks** according to recommended guideline.
B	3. Refer patients to hospital who display any features of acute severe or life threatening asthma.
B	4. Admit patients to hospital with any feature of a life threatening or near fatal attack.
B	5. Admit patients to hospital with any feature of a severe attack persisting after initial treatment.
C	6. Admit patients to hospital whose peak flow is less than 75% best or predicted after initial treatment.
C	7. Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from ED unless they meet any of the following criteria, when admission may be appropriate: • still have significant symptoms • concerns about adherence • living alone/socially isolated • psychological problems • physical disability or learning difficulties • previous near-fatal asthma attack • asthma attack despite adequate dose steroid tablets pre-presentation • presentation at night • pregnancy.

Treatment of Acute Asthma			
OXYGEN		**β2 Agonist Bronchodilators**	
C	8. Give supplementary oxygen to all hypoxaemic patients with acute asthma to maintain an SpO_2 level of 94-98%. Lack of pulse oximetry should not prevent the use of oxygen.	**A**	11. Adults with mild and moderate **attacks** of asthma should be treated by pMDI + spacer with doses titrated according to clinical response.
A	9. In hospital, ambulance and primary care, nebulised β_2 agonist bronchodilators should be driven by oxygen.	**A**	12. In hospital, ambulance and primary care, nebulised β_2 agonist bronchodilators should preferably be driven by oxygen.
C	10. The absence of supplemental oxygen should not prevent nebulised β_2 agonist therapy being given if indicated.	**A**	13. Consider continuous nebulisation in patients with severe asthma who respond poorly to an initial bolus dose of β_2 agonist, using an appropriate nebulizer.
		A	14. In acute asthma with life threatening features the nebulised route (oxygen-driven) is recommended.
		A	15. Use high dose inhaled β_2 agonists as first line agents in acute asthma and administer as early as possible. Reserve intravenous β_2 agonists for those patients in whom inhaled therapy cannot be used reliably.
Steroid Therapy		**Ipratropium Bromide**	
A	16. Give steroids in adequate doses in all cases of acute asthma.	**B**	17. Add nebulised ipratropium bromide (0.5 mg 4-6 hourly) to β_2 agonist treatment for patients with acute severe or life threatening asthma or those with a poor initial response to β_2 agonist therapy.
✓	Continue oral prednisolone 40mg daily for at least 5 days or until recovery.		
IV magnesium, antibiotic use, Heliox			
B	18. Consider giving a single dose of IV **magnesium sulphate** for patients with: • Acute severe asthma who have not had a good initial response to inhaled bronchodilator therapy • Life threatening or near fatal asthma.		
✓	IV **Magnesium sulphate** (1.2 - 2g IV infusion over 20 minutes) should only be used following consultation with senior medical staff.		
B	19. Routine prescription of **antibiotics** is not indicated for patients with acute asthma.		
B	20. Heliox is **not** recommended for use in acute asthma outside a clinical trial setting.		

Referral/Admission to the Intensive Care Unit (ICU) for Acute Asthma	
B	21. Refer any patient: • Requiring ventilator support • With acute severe or life threatening asthma, failing to respond to therapy, evidenced by: - Deteriorating PEF - Persisting or worsening hypoxia - Hypercapnea - ABG analysis showing ↓ pH or ↑ H^+ - Exhaustion, feeble respiration - Drowsiness, confusion, altered conscious state - Respiratory arrest.
C	22. All patients transferred to intensive care units should be accompanied by a doctor suitably equipped and skilled to intubate if necessary.
✓	Patients with acute asthma should not be sedated unless this is to allow anaesthetic or intensive care procedures.
Acute Asthma in Pregnancy	
C	23. Give drug therapy for acute asthma as for the non-pregnant patient including systemic steroids and magnesium sulphate.
D	24. Deliver high flow oxygen immediately to maintain oxygen saturation between 94-98%.
Discharge from Hospital	
A	25. Discharge from hospital or ED should be a planned, supervised event which includes self-management planning. It may safely take place as soon as clinical improvement is apparent
A	26. Prior to discharge, in patients should receive written personalised action plans, given by clinicians with expertise in asthma management
B	27. Prescribe inhalers only after the patient has received training in the use of the device and has demonstrated satisfactory technique
A	28. All people attending hospital with acute **attacks** of asthma should be reviewed by a clinician with particular expertise in asthma management, preferably within 30 days

2.2 National recommendations

2.2.1 Risk factors for developing fatal asthma

Confidential enquiries into asthma deaths or near fatal asthma **attacks** from the UK and Ireland have identified a number of factors which contribute to an asthma death. Most deaths from asthma occur before admission to hospital, and usually occur in patients who have chronic asthma, who are on inadequate inhaled corticosteroid therapy with increased reliance on inhaled β_2 agonists (10). There is generally poor perception by the patient or physician caring for the patient of the overall severity of the asthma exacerbation. In addition, inadequate management in the acute event, including using sedation in some cases, are also factors linked to asthma deaths. Deaths from asthma while uncommon are generally preventable and occur usually in association with an acute **attack**. Although most of these patients have chronically

severe asthma, in a minority the fatal attack has occurred suddenly in a patient with mild or moderately severe background disease. Most asthma deaths occur before admission to hospital. Many deaths occur due to patients receiving inadequate treatment with inhaled steroids or steroid tablets and/or inadequate objective monitoring of their asthma, where follow up was inadequate in some and others should have been referred earlier for specialist advice (10).

Level of evidence 2++ (BTS/SIGN 2014)

Risk factors for developing fatal asthma include:

A combination of severe asthma recognised by one or more of:

- previous near-fatal asthma, e.g. previous ventilation or respiratory acidosis
- previous admission for asthma especially if in the last year
- requiring three or more classes of asthma medication
- heavy use of β_2 agonist
- repeated attendances at ED for asthma care especially if in the last year

AND adverse behavioural or psychosocial features recognised by one or more of:

- non-adherence with treatment or monitoring
- failure to attend appointments
- fewer GP contacts
- frequent home visits
- self discharge from hospital
- psychosis, depression, other psychiatric illness or deliberate self harm
- current or recent major tranquilliser use
- denial
- alcohol or drug abuse
- obesity
- learning difficulties
- employment problems
- income problems
- social isolation
- childhood abuse
- severe domestic, marital or legal stress

"Studies comparing near-fatal asthma with deaths from asthma have concluded that patients with near-fatal asthma have identical adverse factors to those described above and that these contribute to the near-fatal asthma attack. Compared with patients who die, those with near-fatal asthma are significantly younger, are significantly more likely to have had a previous near-fatal asthma attack, are less likely to have concurrent medical conditions, are less likely to experience delay in receiving medical care, and more likely to have ready access to acute medical care."

Level of evidence 2+ (BTS/SIGN 2014)

"With near-fatal asthma it is advisable to involve a close relative when discussing future management." (BTS/SIGN 2014)

Good practice point
√ Keep patients who have had a near-fatal asthma attack under specialist supervision indefinitely

All personnel who may be in contact with a patient with an acute asthma attack e.g. GP practice receptionists, pre-hospital emergency care practitioners and responders, out of hours staff and community pharmacists, should be aware that asthma patients complaining of respiratory symptoms may require immediate access to a physician or a nurse trained in acute asthma management as they may deteriorate suddenly.

Patients' with asthma should have an agreed guided written asthma management plan - this can be disscussed during the follow-up after discharge. They should know when and how to increase their medication and when to seek medical assistance if their asthma is not controlled. Agreed treatment steps should be clearly illustrated within the written asthma management plan. Such plans can decrease acute asthma, hospitalisation and deaths from asthma.

Responsibility recommendation 1: All healthcare professionals

Recommendation 1: Healthcare professionals must be aware that patients who present with a severe asthma attack and one or more adverse psychosocial factors are at risk of death
Grade: B

2.2.2 Management of acute asthma attacks

What is best practice management of patients with an acute asthma attack in primary care?

Patients with asthma including all patients with severe asthma should have an agreed written asthma management plan, with regular checks of inhaler technique and medication compliance at every clinical assessment with the healthcare system.

Patients should know when and how to increase their medication and when to seek medical assistance. This should be contained within the written asthma management plan with treatment steps clearly illustrated. Such plans can decrease hospitalisation for and deaths from asthma.

De-escalating treatment steps must also be outlined in management plan once acute episode is resolved.

All personnel who may be in contact with a patient with an acute asthma attack e.g. GP practice receptionists, pre-hospital emergency care practitioners and responders, out of hours staff and community pharmacists, should be aware that asthma patients complaining of respiratory symptoms should have immediate access to a physician or a nurse trained in acute asthma management as they may deteriorate rapidly.

"The assessments required to determine whether the patient is suffering from an acute attack of asthma, the severity of the attack and the nature of treatment required are detailed in this guideline. It may be helpful to use a systematic recording process. Proformas such as protocols and care bundles in Appendix 2 have proved useful in acute asthma management"

(BTS/SIGN 2014)

The vast majority of acute asthma attacks are managed at Primary Care level including GP Out of Hours (GPOOH) settings. These attacks are characterised by worsening symptoms including shortness of breath, cough, wheezing or chest tightness, or a combination of these symptoms.

Factors which may increase the likelihood of an attack include:

- Non adherence with regular asthma therapy
- Failure to attend for regular follow up after an **attack**
- Self discharge from hospital following an **attack**
- Psychological issues
- Drug/Alcohol abuse
- Obesity
- Learning difficulties
- Social issues

(BTS/SIGN 2014)

Some key points when dealing with an **attack** include:

- Take a good history from the patient in order to:
  - Identify when symptoms started?
  - How have symptoms progressed?
  - What therapy has the patient taken to deal with asthma symptoms to date?
  - Has a similar episode occurred in the past

It is important to be aware that patient's symptoms may underestimate the severity of the attack and to have objective measurements of the event, to include:

- Peak expiratory flow (PEF) or FEV1
- Respiratory rate
- Heart rate
- Oxygen saturation (when available)

The severity of asthma exacerbation can be categorised according to the algorithms included in this guideline (see Appendix 2).

Good practice point

√ Ongoing education of GP practice staff in dealing with acute asthma should be in place. This involves doctors, nurses and practice reception/telephone staff to ensure that patients with asthma are offered prompt appointments.

√ GP support is required to allow patients who are seen in an acute event to be followed up and offered structured care and education. This may involve making contact per phone or flagging notes when patient attends again for any reason including repeat prescriptions.

What are the criteria for referral to the Emergency Department for patient with an acute asthma attack?

Always dial **999/112** if:

- Symptoms persist
- No immediate improvement in symptoms after initial treatment or within 5 minutes after treatment
- Too breathless or exhausted to talk
- Lips turn blue
- Or if in doubt

Most deaths from asthma occur before admission to hospital.

Protocols for the emergency treatment of asthma attacks in the pre-hospital setting can be found on the Pre-Hospital Emergency Care Council (PHECC), www.phecc.ie, and are replicated in Appendix 2.

What are the Hospital Admission Criteria with an acute asthma attack?

Criteria for admission

"Adult patients with any feature of a life-threatening or near-fatal asthma attack or a severe asthma attack that does not resolve after initial treatment should be admitted to hospital. Admission may also be appropriate when peak flow has improved to greater than 75% best or predicted one hour after initial treatment but concerns remain about symptoms, previous history or psychosocial issues." (BTS/SIGN 2014)

Admit patients with any feature of a life-threatening or near-fatal asthma attack.

Admit patients with any feature of a severe asthma attack persisting after initial treatment.

Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from ED unless they meet any of the following criteria, when admission may be appropriate:

- still have significant symptoms
- concerns about adherence
- living alone/socially isolated
- psychological problems
- physical disability or learning difficulties
- previous near-fatal asthma attack
- asthma attack despite adequate dose steroid tablets pre-presentation
- presentation at night
- pregnancy.

(BTS/SIGN 2014)

Asthma attacks (attacks of acute asthma) are associated with progressive increase in asthma symptoms (typically, shortness of breath (SOB), cough, wheeze, chest tightness or any combination of these) but the patient's own perception of asthma symptoms in some cases may be poor and thus unreliable. In addition to symptoms there is usually an objective decrease in expiratory flow rates on lung function testing. This should be quantified by PEF or spirometry (FEV_1). The PEF or FEV_1 expressed as percentage (%) of personal best is the most useful clinically but in the absence of this the % predicted value is a rough guide. Of note a reduction to 50% or less from predicted or best values indicates a severe attack. Pulse oximetry can be of use as low oxygen levels may indicate the necessity for referral to hospital but normal levels greater than 92% do not exclude a severe asthma attack. These measures along with history, examination, pulse and respiratory rate and response to treatment are all required to determine the need for hospitalisation or risk of relapse after acute management. The assessment and management should follow the guidelines outlined in the following acute asthma management protocols.

The **SEVERITY** evaluation of an attack is important and should be determined as to whether it is mild, moderate, severe or life-threatening. Severe or life-threatening attacks require close observation and should be referred to an Emergency Department (ED). Patients with life threatening features at any time during the initial assessment in ED should be admitted to hospital for at least 24 hours. In addition, patients with severe features persisting after the first salbutamol nebulisation should be considered for admission until stable.

Patients at high risk of asthma deaths include those with:

- History of near fatal asthma requiring intubation and mechanical ventilation
- Hospital admission or ED attendance in past year
- Those using or recently stopped oral steroids
- Over use of β_2 agonists (more than 1 inhaler per month)
- Psychiatric disease or psychosocial problems including sedative use
- History on non-compliance with asthma medication plan.

Recognition of acute asthma is done by assessing the level of severity of the patient and this includes the clinical history, examination, (including chest, pulse and respiration rates), peak flow rates (PEF) with peak flow meter and oxygen saturation (SpO_2) with a pulse oximeter.

Responsibility recommendation 2: Clinicians in primary and secondary care

Recommendation 2: Clinicians in primary and secondary care should treat asthma exacerbations according to recommended guidelines.
Grade: B

Responsibility recommendation 3: General practitioners

Recommendation 3: Refer patients to hospital who display any features of acute severe or life threatening asthma.
Grade: B

Responsibility recommendation 4: Clinicians

Recommendation 4: Admit patients to hospital with any feature of a life threatening or near fatal attack.
Grade: B

Responsibility recommendation 5: Clinicians

Recommendation 5: Admit patients to hospital with any feature of a severe attack persisting after initial treatment.
Grade: B

Responsibility recommendation 6: Clinicians

Recommendation 6: Admit patients to hospital whose peak flow is less than 75% best or predicted
Grade: C

Responsibility recommendation 7: Clinicians

Recommendation 7: Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from ED unless they meet any of the following criteria, when admission may be appropriate:

- still have significant symptoms
- concerns about adherence
- living alone/socially isolated
- psychological problems
- physical disability or learning difficulties
- previous near-fatal asthma attack
- asthma attack despite adequate dose steroid tablets pre-presentation
- presentation at night
- pregnancy.

Grade: C

What are the signs to distinguish the severity of an asthma attack?

In acute asthma it is important to assess and record the level of severity as in the tables below.

Delay in treatment and under-dosing in an asthma attack can adversely affect outcomes. By using objective measures, the level of asthma severity is less likely to be underestimated. This will enable prompt treatment at the right dose to be effective.

Table 5 Levels of severity for adults

Level of Severity	
Life Threatening Asthma Features	
Peak Flow Rate (PEF)	PEF <33% best or predicted
Oxygen Saturation (SpO_2)	SpO_2<92%
Speech	Unable to talk - Exhausted, confusion, or coma
Respiratory Examination	Poor respiratory effort, silent chest, cyanosis
Pulse	Bradycardia, arrhythmia
BP	Hypotension
Severe Asthma Features	
Life Threatening Features	No life threatening features
Peak Flow Rate (PEF)	PEF 33–50% best or predicted
Oxygen Saturation (SpO_2)	SpO_2>92%
Speech	Cannot complete sentence in one breath
Respiratory Examination	Respiration Rate>25 breaths/min
Pulse	Pulse Rate >110 beats/min
BP	Normal
Moderate Asthma Features	
Life Threatening Features	No life threatening features
Peak Flow Rate (PEF)	PEF between 50-75% best or predicted
Oxygen Saturation (SpO_2)	Greater than 92%
Speech	Talks in phrases, and prefers to sit
Respiratory Examination	Loud wheeze and respiratory rate less than 25 breaths/min
Pulse	Mild tachycardia but less than 110 beats/min
BP	Normal
Mild Asthma Feature	
Life Threatening Features	No life threatening features
Peak Flow Rate (PEF)	Greater than 75% best or predicted
Oxygen Saturation (SpO_2)	Greater than 92%
Speech	Talks in sentences and can lie down
Respiratory Examination	Mild wheeze and respirations less than 25 breaths/min
Pulse	Pulse is less than 100 beats/min
BP	Normal

Clinical features

"Clinical features can identify some patients with severe asthma, e.g. severe breathlessness (including too breathless to complete sentences in one breath), tachypnea, tachycardia, silent chest, cyanosis, accessory muscle use, altered consciousness or collapse. None of these singly or together is specific. Their absence does not exclude a severe attack."

Level of evidence 2+ (BTS/SIGN 2014)

What are the key components of an objective assessment of an attack in the adult asthma patient?

Pulse oximetry

Good clinical practice would support a measure of oxygen saturation (SpO_2) with a pulse oximeter to determine the adequacy of oxygen therapy and the need for arterial blood gas (ABG) measurement. The aim of oxygen therapy is to maintain SpO_2 94-98%. In hypoxic patients it is important to consider alternative diagnosis e.g. Pneumothorax or pneumonia.

PEF or FEV_1

"Measurements of airway calibre improve recognition of the degree of severity, the appropriateness or intensity of therapy, and decisions about management in hospital or at

home. PEF or FEV_1 are useful and valid measures of airway calibre. PEF is more convenient in the acute situation. PEF expressed as a percentage of the patient's previous best value is most useful clinically. PEF as a percentage of predicted gives a rough guide in the absence of a known previous best value. Different peak flow meters give different readings. Where possible the same or similar type of peak flow meter should be used."

Level of evidence 2+ (BTS/SIGN 2014)

Chest X-ray

"Good clinical practice suggests that a Chest X-ray is not routinely recommended in patients with an asthma attack in the absence of:

- suspected pneumomediastinum or pneumothorax
- suspected consolidation
- life threatening asthma
- failure to respond to treatment satisfactorily
- requirement for ventilation"

Level of evidence 4 (BTS/SIGN 2014)

Blood gases

"Patients with SpO_2 less than (<) 92% (irrespective of whether the patient is on air or oxygen) or other features of life threatening asthma require ABG measurement. SpO_2 less than 92% are associated with a risk of hypercapnea (raised blood CO_2). Hypercapnea is not detected by pulse oximetry. In contrast the risk of hypercapnea with SpO_2 greater than 92% is much less."

Level of evidence 2+ and 4 (BTS/SIGN 2014)

What is the best practice treatment of the adult asthma patient during an acute attack?

The primary therapies for the management of an attack to relieve airflow obstruction and hypoxemia include:

- Repetitive administration of rapid-acting inhaled β_2 agonist bronchodilator via pMDI with spacer or O_2 driven nebuliser
- Early introduction of systemic glucocorticosteroids
- Oxygen supplementation
- (The clinician may decide if antibiotic therapy is appropriate in some cases)

Oxygen

"Many patients with acute severe asthma are hypoxemic (low blood oxygen). Supplementary oxygen should be given urgently to hypoxemic patients, using a face mask, Venturi mask or nasal cannula with flow rates adjusted as necessary to maintain SpO_2 of 94-98%." (BTS/SIGN 2014)

"Hypercapnea (raised blood CO_2 levels) indicates the development of near-fatal asthma and the need for emergency specialist/anaesthetic intervention".

Level of evidence 2+, 4 (BTS/SIGN 2014)

Responsibility recommendation 8: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 8: Give supplementary oxygen to all hypoxaemic patients with acute severe asthma to maintain SpO_2 level of 94-98%. Lack of pulse oximetry should not prevent the use of oxygen.
Grade: C

Responsibility recommendation 9: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 9: (see β_2 agonist recommendations)
In hospital, pre-hospital emergency care and primary care, nebulised β_2 agonist bronchodilators should preferably be driven by **oxygen.**
Grade: A

Responsibility recommendation 10: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 10: (see β_2 agonist recommendations)
The absence of supplemental oxygen should not prevent nebulised β_2 agonist therapy being given if indicated
Grade: C

β_2 agonist bronchodilators – repeated administration of rapid-acting inhaled β_2 agonist

"In most cases inhaled β_2 agonists given in high doses act quickly to relieve bronchospasm with few side effects. There is no evidence for any difference in efficacy between salbutamol and terbutaline. Nebulised adrenaline (epinephrine), a non-selective β_2 agonist, does not have significant benefit over salbutamol or terbutaline." (BTS/SIGN 2014)

In acute asthma without life threatening features, "β_2 agonists can be administered by repeated activations of a pressurised metered dose inhaler (pMDI) via an appropriate large volume spacer or by wet nebulisation driven by oxygen, if available. Inhaled β_2 agonists are as efficacious and preferable to intravenous β_2 agonists (meta-analysis has excluded subcutaneous trials) in adult acute asthma in the majority of cases. Metered dose inhalers with spacers can be used for patients with attacks of asthma other than life threatening" (BTS/SIGN 2014). The bronchodilator therapy delivered via metered-dose inhaler pMDI, ideally with a spacer, produces at least an equivalent improvement in lung function as the same dose delivered via nebulizer. This route of delivery is the most cost effective, provided patients are able to use an pMDI with spacer assistance.

Mild/Moderate attacks: give up to 12 puffs via spacer, one at a time and inhaled separately. Assess after 10-20 minutes. Repeat as necessary (3 doses in total). No additional medication is necessary if the rapid-acting inhaled β_2 agonist produces a complete response (FEV_1 or PEF returns to greater than 80% of predicted or personal best) and the response lasts for 3 to 4 hours.

"Oxygen-driven nebulisers are preferred for nebulising β_2 agonist bronchodilators because of the risk of oxygen desaturation while using air-driven compressors".

Level of evidence 1++ (BTS/SIGN 2014).

Emergency oxygen should be available in hospitals, ambulances and primary care.
"A flow rate of 6 litres/min is required to drive most nebulisers. Where oxygen cylinders are used, a high flow regulator must be fitted."

Level of evidence 4 (BTS/SIGN 2014)

"The absence of supplemental oxygen should not prevent nebulised therapy from being administered when appropriate".

Level of evidence 4 (BTS/SIGN 2014)

"Repeat doses of β_2 agonists at 15-30 minute intervals or give continuous nebulisation of salbutamol at 5-10 mg/hour (requires appropriate nebuliser) if there is an inadequate response to initial treatment." (BTS/SIGN 2014)

"Parenteral β_2 agonists, in addition to inhaled β_2 agonists, may have a role in ventilated patients or those in extremis; however there is limited evidence to support this". (BTS/SIGN 2014)

"Most cases of acute asthma will respond adequately to bolus nebulisation of β_2 agonists. Continuous nebulisation of β_2 agonists with an appropriate nebuliser may be more effective than bolus nebulisation in relieving acute asthma for patients with a poor response to initial therapy".
Level of evidence 1+ (BTS/SIGN 2014)

"In acute asthma without life threatening features, β_2 agonists can be administered by repeated activations of a pMDI via an appropriate large volume spacer or by wet nebulisation driven by oxygen, if available. Inhaled β_2 agonists are as efficacious and preferable to intravenous β_2 agonists (meta-analysis has excluded subcutaneous trials) in adult acute asthma in the majority of cases".
Level of evidence: 1 ++ (BTS/SIGN 2014)

"Metered dose inhalers with spacers can be used for patients with attacks of asthma other than life threatening."
Level of evidence 1++ (BTS/SIGN 2014)

Responsibility recommendation 11: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians and nursing staff

Recommendation 11: Adults with mild and moderate exacerbations of asthma should be treated by pMDI + spacer with doses titrated according to clinical response.
Grade: A

Responsibility recommendation 12: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 12:(see oxygen recommendation)
In hospital, pre-hospital emergency care and primary care, nebulised $\beta_2$agonist bronchodilators should preferably be driven by **oxygen.**
Grade: A

Responsibility recommendation 13: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 13: (see oxygen recommendation) Consider continuous nebulisation in patients with severe asthma who respond poorly to an initial bolus dose of β_2 agonist, using an appropriate nebuliser.
Grade: A

Responsibility recommendation 14: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 14: In acute asthma with life threatening features the nebulised route (oxygen-driven) is recommended.
Grade: A

Responsibility recommendation 15: General Practitioners, pre-hospital emergency care practitioners, ED/AMU physicians, asthma specialists and nursing staff

Recommendation 15: Use high dose inhaled β_2 agonists as first line agents in acute asthma and administer as early as possible. Reserve intravenous β_2 agonists for those patients in whom inhaled therapy cannot be used reliably.
Grade: A

Steroids (Glucocorticosteroids)

"Steroids reduce mortality, relapses, potential hospital admission and requirement for β_2 agonist therapy. The earlier they are given in the acute attack the better the outcome".

Level of evidence 1++ (BTS/SIGN 2014)

Oral steroids (0.5 to 1 mg of prednisolone/kg or equivalent during a 24-hour period) should be used to treat an attack, especially if they develop after instituting other short-term treatment options recommended for loss of control. If the patient fails to respond to bronchodilator therapy, as indicated by persistent airflow obstruction, prompt transfer to an acute care setting is recommended, especially if they are in a high-risk group. Response to treatment may take time. Patients should be closely monitored using clinical and objective measures. Response to treatment should continue until measurements of lung function (FEV_1 or PEF) return ideally to previous best or plateau. Patients who can be safely discharged will have responded within the first few hours.

"Steroid tablets are as effective as injected steroids, provided they can be swallowed and retained. Oral prednisolone 40-50 mg daily or parenteral (IV) hydrocortisone 400 mg daily (100 mg six-hourly) is as effective as higher doses. For convenience, steroid tablets may be given as 2 x 25 mg tablets daily rather than 8 - 10 x 5 mg tablets. Where necessary soluble prednisolone (sodium phosphate) 5 mg tablets can be used. In cases where oral treatment may be a problem consider intramuscular (IM) methylprednisolone 160 mg as an alternative to a course of oral prednisolone (this is likely to be a large 4mls injection)."

Level of evidence: 1++ (BTS/SIGN 2014)

"Following recovery from the acute attack steroids can be stopped abruptly. Good practice indicates that doses do not need tapering provided the patient receives inhaled steroids (caution is required for patients on maintenance steroid treatment or rare instances where steroids are required for three or more weeks)".

Level of evidence 1+ (BTS/SIGN 2014)

In addition to systemic (oral, IV, or IM) steroids, inhaled steroids should be continued (or started if not already prescribed) and commence the chronic asthma management plan.

Level of evidence 1+ (BTS/SIGN 2014)

Responsibility recommendation 16: Clinicians

Recommendation 16: Give steroids in adequate doses in all cases of acute asthma
Grade: A

Good practice point
√ Continue oral prednisolone 40mg daily for at least 5 days or until recovery.

Ipratropium bromide

"Combining nebulised ipratropium bromide with a nebulised β_2 agonist produces significantly greater bronchodilation than a β_2 agonist alone, leading to a faster recovery and shorter dura-

tion of admission. Anticholinergic treatment is not necessary and may not be beneficial in milder attacks of asthma or after stabilisation".

Level of evidence 1++ (BTS/SIGN 2014)

Responsibility recommendation 17: Clinicians

Recommendation 17: Add nebulised ipratropium bromide (0.5 mg 4-6 hourly) to β_2 agonist treatment for patients with acute severe or life threatening asthma or those with poor initial response to β_2 agonist therapy.
Grade: B

Magnesium sulphate

"There is some evidence that, in adults, magnesium sulphate has bronchodilator effects." (BTS/SIGN 2014). Experience suggests that magnesium is safe when given by the intravenous (IV) or nebulised route. Trials comparing these routes of administration are awaited. Studies report the safe use of nebulised magnesium sulphate, in a dose of 135 mg - 1152 mg, in combination with β_2 agonists, with a trend towards benefit in hospital admission. "A single dose of IV magnesium sulphate is safe and may improve lung function in patients with acute severe asthma" (BTS/SIGN 2014).

Level of evidence 1++ (BTS/SIGN 2014)

"The safety and efficacy of repeated IV doses has not been assessed. Repeated doses could cause hypermagnesaemia with muscle weakness and respiratory failure." (BTS/SIGN 2014) More studies are needed to determine the optimal route, frequency and dose of magnesium sulphate therapy.

Responsibility recommendation 18: Asthma specialists

Recommendation 18: Consider giving a single dose of IV magnesium sulphate for patients with:
- Acute severe asthma who have not had a good initial response to inhaled bronchodilator theraphy
- Life threatening or near fatal asthma.

Grade: B

Good practice point
√ IV magnesium sulphate (1.2 - 2g IV infusion over 20 minutes) should only be used following consultation with senior medical staff.

Intravenous (IV) aminophylline

This drug is generally not for routine use as it may potentially increase morbidity and delay anaesthetic review.

Good practice indicates that it should only be given on the advice of a senior physician.

However, in acute asthma, "IV aminophylline is not likely to result in any additional bronchodilation compared to standard care with inhaled bronchodilators and steroids. Side effects such as arrhythmias and vomiting are increased if IV aminophylline is used."

Level of evidence 1++ (BTS/SIGN 2014)

"Some patients with near-fatal asthma or life threatening asthma with a poor response to initial therapy may gain additional benefit from IV aminophylline (5 mg/kg loading dose over 20 minutes unless on maintenance oral therapy, then infusion of 0.5-0.7 mg/kg/hr). Such patients are probably rare and could not be identified in a meta-analysis of trials. If IV aminophylline is given to patients on oral aminophylline or theophylline, blood levels should be checked on

admission. Levels should be checked daily for all patients on aminophylline infusions." (BTS/SIGN 2014)

Leukotriene receptor agonist

There is some emerging evidence to suggest a possible role of montelukast (singulair) in acute asthma but is insufficient currently to make a recommendation of its use in the management of acute asthma.

Antibiotics

Antibiotics should not be given automatically unless there is strong suspicion of bacterial infection, elevated temperature, raised white cell count, infiltrate on chest x-ray or copious green phlegm and should be guided by local microbiology guidelines.

"When an infection precipitates an asthma attack it is likely to be viral. The role of bacterial infection in an attack has been overestimated."

Level of evidence 1++ (BTS/SIGN 2014)

Routine prescription of antibiotics is not indicated for acute asthma.

Responsibility recommendation 19: Clinicians and community pharmacists

Recommendation 19: Routine prescription of antibiotics is not indicted for acute asthma
Grade: B

Intravenous fluids

There are no controlled trials, observational or cohort studies of IV fluid regimes in acute asthma.

Good practice point

√ Some patients with acute asthma require rehydration and correction of electrolyte imbalance. Hypokalaemia can be caused or exacerbated by β_2 agonist and/or steroid treatment and must be corrected. (BTS/SIGN 2014)

Heliox

"The use of heliox, (helium/oxygen mixture in a ratio of 80:20 or 70:30), either as a driving gas for nebulisers, as a breathing gas, or for artificial ventilation in adults with acute asthma is not supported on the basis of present evidence. A systematic review of ten trials (554 patients), including patients with acute asthma, found no improvement in pulmonary function or other outcomes in adults treated with heliox, although the possibility of benefit in patients with more severe obstruction exists. Heliox requires the use of specifically designed or modified breathing circuits and ventilators."

Level of evidence 1++, 1+ (BTS/SIGN 2014)

Responsibility recommendation 20: Clinicians and nursing staff

Recommendation 20: Heliox is not recommended for use in acute asthma outside a clinical trial setting

Nebulized furosemide

"Although theoretically furosemide may produce bronchodilation, a review of three small trials failed to show any significant benefit of treatment with nebulised furosemide compared to β_2 agonists".

Level of evidence; 1+ (BTS/SIGN 2014)

ICU/HDU

"Indications for admission to intensive care or high-dependency units include patients requiring ventilator support and those with severe acute or life threatening asthma who are failing to respond to therapy, as evidenced by:

- deteriorating PEF
- persisting or worsening hypoxia
- hypercapnea
- arterial blood gas analysis showing fall in pH or rising H+ concentration
- exhaustion, feeble respiration
- drowsiness, confusion, altered conscious state
- respiratory arrest.

Not all patients admitted to the Intensive Care Unit (ICU) need ventilation, but those with worsening hypoxia or hypercapnea, drowsiness or unconsciousness and those who have had a respiratory arrest require intermittent positive pressure ventilation. Intubation in such patients is very difficult and should ideally be performed by an anaesthetist or ICU consultant" (BTS/ SIGN 2014). Treatment has to be adjusted periodically in response to worsening control, which may be recognised by the minor recurrence or worsening of symptoms following treatment for an attack, maintenance treatment can be resumed at previous levels unless the attack was associated with a gradual loss of control suggesting chronic under treatment.

Level of evidence; 2+ (BTS/SIGN 2014)

Responsibility recommendation 21: Clinicians

Recommendation 21: Refer to the ICU any patient:

- Requiring ventilator support
- With acute severe or life threatening asthma, failing to respond to initial therapy, evidenced by:
  - Deteriorating PEF
  - Persisting or worsening hypoxia
  - Hypercapnea
  - ABG analysis showing ↓ pH or ↑ H^+
  - Exhaustion, feeble respiration
  - Drowsiness, confusion, altered conscious state
  - Respiratory arrest

Grade: B

Responsibility recommendation 22: Clinicians and nursing staff

Recommendation 22: All patients transferred to intensive care units should be accompanied by a doctor suitably equipped and skilled to intubate if necessary
Grade: C

Good practice point
√ Patients with acute asthma should not be sedated unless this is to allow anaesthetic or intensive care procedures

Non invasive ventilation

"A Cochrane review found only one trial, with 30 patients, on NIV which showed improvement in hospitalisation rates, discharge from emergency departments and lung function. Larger RCTs are needed to determine the role of NIV in treating patients with acute asthma".

Level of evidence: 1++ (BTS/SIGN 2014)

Good practice point

√ NIV for acute asthma should only be considered in an ICU or equivalent clinical setting.

Structured proforma

"The use of structured proformas facilitates improvements in the process of care in emergency departments and hospital wards and improves patient outcomes. The use of this type of documentation can assist data collection aimed at determining quality of care and outcomes".

Level of evidence: 2 + (BTS/SIGN 2014)

What is best practice management of an acute asthma attack in pregnancy?

"The management of acute asthma in pregnancy may be affected by concerns about harmful effects of medications on the fetus" (BTS/SIGN 2014). However the maternal and fetal risks of uncontrolled asthma are much greater than the risks from conventional asthma medications and acute asthma remains an important cause of maternal mortality. The Confidential Enquiry into Maternal Deaths 2006-2008 reported 5 maternal deaths from asthma (19).

The ultimate goal of asthma therapy in pregnancy is maintaining adequate oxygenation of the fetus by preventing hypoxic episodes in the mother. It should be emphasised that it is safer for pregnant women with asthma to be treated with medications than it is for them to have ongoing asthma symptoms and attacks. Pregnant women with asthma should be counselled regarding the importance of compliance with treatment during pregnancy to ensure good asthma control. Inhaled corticosteroids are first-line controller therapy for persistent asthma during pregnancy.

"Prednisolone is extensively metabolised in the placenta such that only 10% reaches the fetus" (BTS/SIGN 2014). Steroid therapy in the first trimester may be associated with an increased risk of oral clefts in the fetus. However, women should be advised that if required, the benefits of treatment with oral steroids for asthma attacks outweigh the risks thereof.

It is important that treatment with steroids should not be withheld if indicated for the management of an asthma attack because of pregnancy.

The inhaled short acting β_2 agonist, salbutamol, is recommended rescue therapy for pregnant women with asthma. No significant association has been demonstrated between major congenital malformations or perinatal outcomes and exposure to short acting β_2 agonists.

2.2.3 Management of acute asthma in pregnancy

1. Patients presenting to the Emergency Room in a Maternity Hospital with an acute asthma attack should be assessed according to acute adult asthma guidelines.
2. Pregnancy should not alter the standard management of an acute asthma attack.
3. Patients presenting to the Emergency Room in a Maternity Hospital with an acute LIFE THREATENING ASTHMA attack should be given salbutamol via oxygen driven nebuliser and immediately referred to a General Hospital or service with respiratory medicine expertise and ICU facilities.

4. Consider intensive care medicine consult with senior anaesthetist and need for possible intubation and ventilation for those patients with deteriorating condition.
5. Continuous fetal monitoring is recommended in cases of severe or life threatening acute asthma presentation.
6. If a patient with LIFE THREATENING ASTHMA requires delivery this should be performed by an obstetric team in a general hospital with ICU and respiratory physician back up.
7. A patient with a SEVERE/MODERATE asthma attack not improved by initial nebulizer and oxygen treatment should be immediately transferred to a general hospital with ICU facilities.
8. CXR*/ECG/ABG should be performed in patients presenting with acute asthma attack (except where the presentation is MILD).
   * use abdominal shielding and defer unless deemed urgent in the first trimester.
9. Respiratory physician input should be sought regarding the ongoing management of pregnant patients admitted to a maternity hospital with an asthma attack. A consultation with a respiratory physician to advise on further treatment options and follow up on discharge.
10. Patients presenting with an acute asthma attack in pregnancy should be followed up on discharge with the respiratory service to reduce incidence of further attack in pregnancy.
11. Consideration for other pathologies should be given for women presenting in pregnancy with respiratory symptoms similar to acute asthma including those who do not have a history of asthma. Pulmonary embolism, pulmonary oedema secondary to pre-eclampsia, puerperal cardiomyopathy, pneumonia, ischemic or valvular heart disease may also present with shortness of breath, hypoxia or respiratory wheeze.

Responsibility recommendation 23: Clinicians and nursing staff

Recommendation 23: Give drug therapy for acute asthma as for the non-pregnant patient including systemic steroids and magnesium sulphate
Grade: C

Responsibility recommendation 24: Clinicians and nursing staff

Recommendation 24: Deliver high flow oxygen immediately to maintain oxygen saturation between 94-98%
Grade: D

2.2.4 Discharge and follow-up

What discharge and follow-up planning is required for patients with an acute asthma attack?

People with a life threatening/severe asthma attack should be admitted for at least 24 hours and should be reviewed by senior physician/ respiratory consultant before discharge. Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from ED unless they meet any of the following criteria when admission may be appropriate:

- Still have significant symptoms
- Previous near-fatal or brittle asthma
- Had an attack despite adequate dose steroid tablets pre-presentation
- Presentation at night
- Pregnancy.

What role can patient education play in asthma management following an acute asthma attack?

"Following discharge from hospital or emergency departments, a proportion of patients re-attend. International data has shown that more than 15% re-attended within two weeks. Some repeat attenders need emergency care, but many delay seeking help, and are under-treated and/or under-monitored".

Level of evidence 2+ (BTS/SIGN 2014)

"Prior to discharge, trained staff should give asthma education. This should include education on inhaler technique and PEF performance and record keeping. A written PEF and symptom-based action plan should be provided allowing the patient to adjust their therapy within agreed parameters. These measures have been shown to reduce morbidity after the attack and reduce relapse rates".

Level of evidence 1++ (BTS/SIGN 2014)

"There is some experience of a discrete population of patients who use emergency departments rather than primary care services for their asthma care. Education has been shown to reduce subsequent hospital admission and improve scheduled appointments and self management techniques but does not improve re-attendance at emergency departments". (BTS/SIGN 2014)

"For the above groups there is a role for a trained asthma liaison nurse based in, or associated with, the emergency department."

Level of evidence 1++ (BTS/SIGN 2014)

All patients following an asthma attack should be educated in the management of their condition which can be provided by healthcare professionals trained in asthma management. This should include;

- Awareness of triggers and symptoms of onset of attack
- Medications compliance
- Inhaler technique (see www.hse.ie, www.irishthoracicsociety.com, www.asthmasociety.ie for copies of checklists)
- Peak flow technique and diary recording
- Asthma Management Plan (see Appendix 2.5)

People requiring further supports prior to discharge should be referred to appropriate services. Such patients include:

- Those who live alone or are socially isolated
- Those who have behavioral or psychological problems
- Substance misuse
- Those who have a physical disability or learning difficulties
- Those who are currently on sedatives or psychiatric medication

"Prior to discharge, trained staff should give asthma education. This should include education on inhaler technique and PEF performance and record keeping. A written PEF and symptom-based action plan should be provided allowing the patient to adjust their therapy within agreed parameters. These measures have been shown to reduce morbidity after the attack and reduce relapse rates".

Level of evidence 1++ (BTS/SIGN 2014)

"There is some experience of a discrete population of patients who use emergency departments rather than primary care services for their asthma care. Education has been shown to reduce subsequent hospital admission and improve scheduled appointments and self management techniques but does not improve re-attendance at emergency departments." (BTS/SIGN 2014)

"For the above groups there is a role for a trained asthma liaison nurse based in, or associated with, the emergency department."

Level of evidence 1++ (BTS/SIGN 2014)

What should the follow up process be after an acute asthma attack?

"A careful history should elicit the reasons for the attack and explore possible actions the patient should take to prevent future emergency presentations. Medication should be altered depending upon the assessment and the patient should be provided with an asthma action plan aimed at preventing relapse, optimising treatment and preventing delay in seeking assistance in the future." (BTS/SIGN 2014).

It is recommended that follow up be arranged prior to discharge with the patient's general practitioner or asthma nurse / hospital specialist asthma/respiratory service as follows:

- The appropriate General Practice should be informed and receive appropriate discharge summary by fax / email within 24 hours of the patient's discharge
- Before discharge the patient should be instructed to arrange an appointment with their GP or practice nurse within 2 working days of discharge.
- A requisition for a follow-up appointment with a hospital asthma / respiratory service should be made within 4 weeks of the episode.

"Assisting patients in making appointments while being treated for acute asthma in emergency departments may improve subsequent attendance at primary care centres."

Level of evidence 1+ (BTS/SIGN 2014)

Discharge bundle following an acute adult asthma attack

A sample discharge bundle can be found in Appendix 2.2.

Discharge letter/fax/email template following an acute adult asthma attack

A sample discharge letter/fax/email template can be found in Appendix 2.3. A copy of the discharge letter should be provided to each of the following:

- the patient with asthma attack or their carer
- the patient's named GP /practice nurse
- care home/community nurse (where appropriate)
- Discharge from hospital or ED should be a planned, supervised event which includes self-management planning. It may safely take place as soon as clinical improvement is apparent.
- Prior to discharge, in patients should receive written personalised action plans, given by clinicians with expertise in asthma management.
- Prescribe inhalers only after the patient has received training in the use of the device and has demonstrated satisfactory technique.
- All people attending hospital with acute attack of asthma should be reviewed by a clinician with particular expertise in asthma management, preferably within 30 days.

Responsibility recommendation 25: All healthcare staff

Recommendation 25:
Discharge from hospital or ED should be a planned, supervised event which includes self-management planning. It may safely take place as soon as clinical improvement is apparent and sustained
Grade: A

Responsibility recommendation 26: Clinicians and nursing staff

Recommendation 26:
Prior to discharge, in patients should receive written personalised action plans, given by clinicians with expertise in asthma management.
Grade: A

Responsibility recommendation 27: Clinicians

Recommendation 27:
Prescribe inhalers only after the patient has received training in the use of the device and has demonstrated satisfactory technique.
Grade: B

Responsibility recommendation 28: Clinicians

Recommendation 28:
All people attending hospital with acute exacerbations of asthma should be reviewed by a clinician with particular expertise in asthma management, preferably within 30 days.
Grade: A

3 Appendices and references

Appendix 1: Guideline Development Group

Appendix 1.1 Terms of reference

To develop a national evidence-based clinical guideline for the management of acute adult asthma attacks

Appendix 1.2. Membership of Guideline Development Group

National Clinical Programme Lead	Prof. Pat Manning, Respiratory Consultant, Midland Regional Hospital , Mullingar
ICGP Lead	Dr Dermot Nolan, General Practitioner, Tramore Medical Clinic, Waterford
Public Health Specialist	Dr Ina Kelly, Consultant in Public Health, HSE, Tullamore
Patient Organisation	Dr Jean Holohan, CEO Asthma Society of Ireland (2006-2012) Sharon Cosgrove, CEO Asthma Society of Ireland (2012-date)
Clinical Nurse Specialist (Adult)	Ann Tooher, Midland Regional Hospital, Mullingar
Clinical Nurse Specialist (Children)	Niamh O'Regan, Mullingar Midland Hospital, Mullingar (2010-2013)
Advanced Nurse Practitioner Asthma (Children)	Mary McDonald, Tallaght Hospital, Dublin
Professional Development Coordinator for Practice	Rhonda Forsythe, Practice Nurse Development Co-ordinator, HSE
Nursing Service Planner	Marian Wyer, HSE, Tullamore
Respiratory Scientists	Maria McNeill, Respiratory Scientist, Midland Regional Hospital, Mullingar (2010-2012) Tom Kelly, Respiratory Scientist, Mater Misericordiae Hospital, Chair of IARS (2012-2014) Geraldine Nolan, Respiratory Scientist, St Vincent's University Hospital, Dublin 4
Therapy Professions Representative	Joanne Dowds, Clinical Specialist Physiotherapist, St.James Hospital, Dublin 8

Programme Managers	Vanessa Colgan, Clinical Strategy and Programmes Directorate , HSE (2010-2013) Noreen Curtin, Clinical Strategy and Programmes Directorate, HSE (2013-2014) Regina Black, Clinical Strategy and Programmes Directorate, HSE (2014-2015) Linda Kearns, Clinical Stategy and Programmes Directorate
Health Intelligence Unit	Davida DeLaHarpe, Head Health Intelligence Unit, HSE QCCD Anne O'Farrell, Health Intelligence Unit, HSE QCCD
Irish Pharmacy Union	Pamela Logan, Director Pharmacy Service, IPU
Pharmacist	Kathleen Niamh Buckley, Trinity College Dublin and St James's Hospital, Dublin 8
Contributors and Consultation Participants	
Regional Lead DNE	Dr John Faul, Respiratory Consultant, Connolly Hospital, Dublin
Regional Lead DML	Prof Stephen Lane, Respiratory Consultant, Tallaght Hospital, Dublin 24
Regional Lead South	Dr Terry O'Connor, Respiratory Consultant, Mercy University Hospital, Cork
Regional Lead West	Dr Robert Rutherford, Respiratory Consultant, Merlin Park Hospital, Galway (up to March 2012) Prof. Anthony O'Regan, University Hospital Galway (March 2012 to date)
RCPI / ITS Clinical Advisory Group	Regional Leads and the following RCPI/ITS Nominees Dr Aidan O'Brien, Respiratory Consultant, Mid Western Regional Hospital Limerick Dr Barry Linnane, Respiratory Consultant, Mid Western Regional Hospital Limerick Dr Basil Elnazir, Paediatric Respiratory Consultant, Tallaght Hospital, Dublin 24 Dr Des Murphy, Respiratory Consultant, Cork University Hospital

Guideline National Consultative Groups	
National Emergency Medicine Programme	Dr Una Geary, ED Programme Lead, Consultant in Emergency Medicine, St. James Hospital, Dublin 8 Prof. Ronan O'Sullivan, Head of Paediatrics, School of Medicine & Medical Science, UCD , Consultant in Paediatric Emergency Medicine Our Lady's Children's Hospital Crumlin, Dublin 8
National Acute Medicine Programme	Dr Garry Courtney, Acute Medicine Programme Lead, Clinical Director, St Luke's Hospital Kilkenny Prof Shane O'Neill, Acute Medicine Programme Lead, Respiratory Consultant, Beaumont Hospital, Dublin 7
National Paediatric Programme	Prof Alf Nicholson, Consultant Paediatrician, Children's University Hospital, Temple Street, Dublin
Pre-Hospital Emergency Care Council	Dr Geoff King, Director, Pre-Hospital Emergency Care Council (R.I.P) Brian Power, Pre-Hospital Emergency Care Council
National Critical Care Programme	Dr Michael Power, National Clinical Lead
Irish College of General Practicitioners (ICGP)	Quality in Clinical Practice Committee
External Reviewer International Asthma Advisor Chairman of Scientific Committee GINA	Prof Mark Fitzgerald, Professor of Medicine, Head, UBC and VGH Divisions of Respiratory Medicine, Director, Centre for Lung Health, The Lung Centre, Vancouver, Canada
DCU School of Nursing and Human Sciences Faculty of Science and Health	Dr Veronica Lambert, Deputy Head of School and Senior Lecturer in Nursing Professor Anne Matthews, Head of School and Associate Professor in Health Sciences Ms Jessica Collins, Lecturer in General Nursing Ms Catherine Walshe, Research Assistant

Appendix 1.3. Consultation process

As part of the guideline development process the draft guideline was circulated to key stakeholders for feedback. A summary of the feedback provided during the consultation process in presented below:

Feedback Submitted by:	Feedback Provided:	Incorporation of Feedback:
Clinical Care Programme, Obstetrics and Gynaecology	• Dr Carmen Regan contributed text for the management of acute asthma exacerbation in pregnancy section	• Contribution gratefully received and incorporated into the guideline
Irish Thoracic Society	• ITS supportive of the development of acute asthma guidelines	
Irish College of General Practitioners (ICGP)	• ICGP supportive of the development of acute asthma guidelines	
Pre-Hospital Emergency Care Council (PHECC)	• Inclusion of 'PHECC' in Glossary	• PHECC inserted in glossary
	• Inclusion of Pre-Hospital emergency care practitioners and PHECC in table 4 Roles and responsibilities of stakeholders	• Table 4 updated
Emergency Medicine Programme	• Asked to consider dosage of IM methylprednisolone	• 160mg recommended by BTS/SIGN guideline and agreed by NCPA CAG members
	• Advised that early clinical input by Critical Care teams, particularly consultation with Critical Care Programme before the patient needs intubation, be included	• Feedback incorporated into the guideline
	• Suggested that people requiring further supports prior to discharge should also include those with a history of substance misuse	• Feedback incorporated into the guideline
	• Suggested that follow up after discharge takes place 'within 4 weeks of the episode'	• Feedback incorporated into the guideline
	• Suggested inclusion of 'treatment protocols will be carried out by Emergency/Acute Medicine/ Respiratory teams.'	• Feedback incorporated into the guideline

Appendix 2: Summary of tools to assist in implementation of National Clinical Guideline

The following tools are presented in Appendix 2:

2.1. Emergency Treatment Protocols for Management of Acute Adult Asthma
Emergency treatment protocols are standardised flow of treatment to be applied to the acute asthmatic
- Management of Acute Adult Asthma in ED, AMU & In hospital
- PHECC clinical practice guidelines (CPGs)

2.2. Emergency Treatment Care Bundles for Management of Acute Adult Asthma
- Management of asthma attack in general practice care bundle
- Life Threatening Asthma Attack Care bundle
- Severe/Moderate Asthma Attack Care Bundle
- Asthma Patient Discharge Care Bundle

2.3. Discharge Letter, Fax, Email Template for Management of Acute Adult Asthma

2.4. Audit Form for Emergency Asthma Care

2.5. Asthma Management Plans

2.6. Peak flow Measurements

2.7. Medications in Acute Asthma

Appendix 2.1 Emergency treatment protocols for management of acute adult asthma

Management of Acute Adult Asthma in ED, AMU and in Hospital

Initial Assessment

Look for LIFE THREATENING FEATURES - take history, physical examination (auscultation, use of accessory muscles, heart rate, respiratory rate, PEF, or FEV_1, oxygen saturation, arterial blood gas if patient in extremis)

PEF < 33% best or predicted
SpO_2 <92% **OR** any one of the

Life Threatening Asthma Features:
- Silent chest, cyanosis, poor respiratory effort
- Bradycardia, arrhythmia,
- Check BP for hypotension
- Exhaustion, confusion, coma

PEF 33–50% best or predicted
SpO_2 >92%

Severe
- PEF <50% (severe)
- Respiration >25 breaths/min
- Pulse > 110 beats/min
- Cannot complete sentence in one breath
- BP Normal

PEF 50-75% best or predicted
SpO_2 >92%
Moderate
- Loud wheeze
- Prefer to sit
- Talks in phrases
- PR<110 Beats/ min
- RR<25 Breaths/ min
- BP Normal

PEF >75% best or predicted
SpO_2 >92%
Mild
- Can lie down
- Talks in sentences
- Mild-Mod wheeze
- PR<100 Beats/ min
- RR<25 Breaths/ min
- BP Normal

Obtain Senior/ICU/ Specialist help now if any life threatening asthma features are present

Give salbutamol 5 mg and ipratropium 0.5mg by oxygen-driven nebuliser

Give salbutamol up to 12 puffs via spacer or oxygen driven nebuliser

Give usual bronchodilator

IMMEDIATE MANAGEMENT
- High concentration oxygen (>60% if possible – goal to maintain sats at 94%)
- Give salbutamol 5 mg plus ipratropium 0.5 mg via oxygen-driven nebuliser
- AND prednisolone 40-50mg orally or IV hydrocortisone 100 mg or 125mg of methyprednisolone

10 -15 mins

Life threatening asthma features OR PEF <50%

No life threatening asthma features AND PEF 50-75%

Clinically stable AND PEF >75%

Repeat salbutamol via inhaler/ nebulizer 5mg at 15-30 min intervals

Give prednisolone 40-50mg orally

Measure arterial blood gases
Markers of severity:
- **Normal or raised $PaCO_2$** (Pa CO_2>4.6kPa)
- **Severe hypoxia** (Pa O_2<8 kPa)
- **Low pH** (or high H^+)

Signs of severe Asthma OR PEF <50%

No signs of severe Asthma AND PEF 50-75%

Patient recovering AND PEF >75%

- Chest X-ray
- 12-Lead ECG
- Give/repeat salbutamol 5 mg with ipratropium 0.5 mg by oxygen-driven nebuliser after 15 minutes
- Consider continuous salbutamol nebuliser 5-10 mg/hr.
- Consider IV magnesium sulphate 2g over 20 minutes
- Correct fluid/electrolytes, especially K+ disturbances

OBSERVE
Monitor SpO_2, Heart rate and Respiratory rate

2 hours

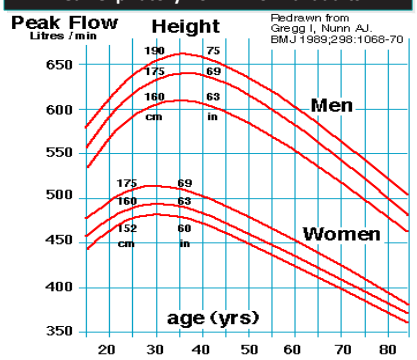
ADMIT for minimum of 24 hours Patient should be accompanied by a nurse or doctor at all times

Signs of severe asthma OR PEF <50%

Patient Stable AND PEF >50%

Start on inhaled Steroids

Peak expiratory flow in normal adults



DISCHARGE PLAN
- In all patients who received nebulised ß2 agonists prior to presentation, consider an extended observation period prior to discharge
- If PEF<50% on presentation, prescribe prednisolone 40-50mg/ day for 5 days. Ensure all patients have a treatment supply
- In all patients ensure treatment supply of inhaled steroid and ß2 agonist as a minimum and check inhaler technique
- PEF meter instruction and written asthma management plan
- Consider psycho-social factors before discharge
- GP follow up within 2 working days post presentation advised for moderate / severe / life-threatening exacerbation (2 weeks – mild)
- Fax Or email discharge letter to GP and copy to patient
- Refer to Asthma/ Respiratory Service for follow up within 4 weeks
- Complete Asthma Discharge Plan
- Consider delay in discharge to 8 am if after midnight

PHECC Clinical Practice Guideline

Reference: HSE National Asthma Programme 2012, Emergency Asthma Guidelines, British Thoracic Society, 2008, British Guidelines on the Management of Asthma, a national clinical guideline

Appendix 2.2 Emergency treatment care bundles for management of acute adult asthma

Adult Asthma Acute Management in General Practice and Primary Care out of hours settings	
Assess and Record: Peak expiratory flow; Symptoms and response to self treatment; Heart and respiratory rates; Oxygen Saturation (by pulse oximetry, if available) **Caution:** *Patients with severe or life threatening attacks may not be distressed and may not have all the abnormalities listed below. The presence of any should alert the doctor* **Regard each emergency asthma consultation as for acute life threatening/severe asthma until it is shown otherwise**	
Date (of review): _____ **Time:** _____	Time Processed Nurse/Physician Initials/Comments
❒ Give Oxygen via face mask if available, 40 – 60%	
If Moderate asthma attack (PEF 50-75%): ❒ Give β_2 agonist via spacer up to 12 puffs (given one at a time and inhaled separately) at intervals of 15 - 30 minutes **If Severe/ Life threatening (< 50%):** ❒ Administer salbutamol 5mg or terbutaline 10mg via oxygen driven nebuliser **If PEF 50-75% predicated/best:** ❒ Administer prednisolone 40 - 50mg orally or ❒ IV hydrocortisone 100mg All patients who received nebulised β_2 agonist, require extended observation period	
❒ Assess response to treatment in 15 minutes post administration of $\beta_2$agonist, continually observing symptoms	
❒ If **NO** response arrange immediate admission to Hospital ED /AMU **Dial 112 0r 999** ❒ Administer High Dose β_2 agonist and ipratropium 0.5mg via nebuliser ❒ Stay with patient until ambulance arrives ❒ Send documentation assessment and referral to hospital ❒ Ensure patient is given high dose β_2 agonist via oxygen driven nebuliser in ambulance	
❒ If **GOOD** response, the patient's symptoms improve ❒ Continue step up of usual treatment and continue course of oral predsnisolone ❒ Ensure the patient has a prescription for β_2 agonist and inhaled steroid (if not already on inhaled steroids) prior to discharge ❒ Commence PEF diary and encourage charting symptoms in the asthma management plan ❒ Check technique of use inhaler and peak flow meter ❒ Demonstrate inhaler technique and peak flow use to new patients and carer as appropriate. ❒ Arrange GP follow up within 2 working days	

Attack of Life Threatening Asthma (Adult) in ED/ AMU Management Bundle	
Life Threatening Asthma **PEF<33% best or predicted OR any one of the <u>life threatening asthma features:</u>** $Sp0_2$ < 92%, silent chest, cyanosis, poor respiratory effort, bradycardia, arrhythmia, hypotension, exhaustion, confusion, coma**. Patient should be monitored continuously**.	
Date:_____ Time:_____	Time Processed Nurse/Physician Initials/Comments
Give high concentration Oxygen (60%) to maintain $Sp0_2$ greater than 94%	
Administer Salbutamol 5mg + Ipratropium 0.5mg by oxygen driven (6-8L/min) nebulizer (within 5 mins of arrival) and repeat every 15mins until improvement from above.	
Prednisolone 40-50 mg PO or IV hydrocortisone 100mg or 125mg methylprednisolone	
Cardiac monitor, pulse oximetry and Insert IV line	
ABG – Measure arterial blood gases Markers of severity: ❒ Normal or raised $PaCO_2$ (Pa CO_2>4.6kPa) ❒ Severe hypoxia (Pa O_2< 8 kPa) ❒ Low pH (or high H+)	
Assess need for intubation and ventilation, if yes contact anaesthetist/Critical care team ❒	
If poor or no response (following consultation with senior physician) ❒ Magnesium sulphate 2g IV in 50ml Normal Saline over 20 minutes	
Chest X-Ray	
12-lead ECG	
FBC, electrolytes, BUN, SCr, blood glucose	
Decision to Admit to ICU/HDU	
Physician Signature _____	Printed Name _____

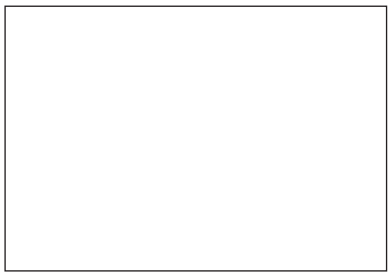
Table for Approved Medications Administration

Medication	Nurse	Nurse Prescriber	Physician
Oxygen	√	√	√
Salbutamol	√	√	√
Ipratropium		√	√
Prednisolone /Methylprednisolone		√	√

Affix Patient Label Here

Asthma Discharge Checklist from ED and AMU	
Review each of the steps and incorporate into your discharge planning process for an Asthma Patient	
Date (of discharge):_____Time_____	Time Processed Nurse/Physician Initials/Comments
❒ Consider psycho-social factors in discharge and refer to MDT or agency if required	
❒ Consider delay in discharge to 8am if after midnight	
❒ If patient received nebulised β_2 agonists prior to presentation to ED/AMU consider an extended observation period (more than 4 hours) prior to discharge	
❒ If PEF < 50% on presentation, prescribe oral prednisolone 40-50 mg/day for 5 days	
❒ Ensure prescription for oral (if required) and inhaled steroid β_2 agonist is supplied to patient on discharge (GMS patient go to GP for medical card prescription)	
❒ Check inhaler technique	
❒ Implement written asthma management plan and diary	
❒ Purchase own PEF meter from Asthma Society of Ireland (ASI) or pharmacy	
❒ Advise patient to arrange GP follow up for within 2 working days of presentation for moderate/ severe/ life-threatening asthma (within 2 weeks – mild)	
❒ Fax or email discharge letter to GP ❒ Copy to Asthma nurse/respiratory service	
Physician Signature _____	Printed Name _____

Affix patient Label here



Appendix 2.3. Discharge letter, fax, email template for management of acute adult asthma

Discharge Letter following acute asthma attack to Emergency Department / Hospital

Hospital Name

Patient Name: _____ DOB: _____

Address _____

Date /time _____

Dear (GP's Name) _____

Age: Height Predicted Peak Flow:

	Initial assessment	*On discharge*
PEF		
SpO_2		
Pulse		
Respiratory rate		

We have discussed
❒ Inhaler use / technique with (type) ……
❒ Medicines including side effects ……
❒ Trigger avoidance ……
❒ Smoking cessation ……
❒ How to recognise worsening asthma and what to do in asthma attack: ……
Was given a leaflet detailing a simple management plan (copy enclosed) ……
……

Other important issues discussed:
1 ……
2 ……
3 ……
……
……

They have been given written information about asthma management

They have been referred to:
Asthma Nurse Specialist ……
Respiratory Consultant ……
Other ……

For follow up appointments.

They have been discharged on the following medications:

Contact Details: Emergency Department
Signature: Hospital
Name:
Title:
Bleep:

Appendix 2.4. Audit form for emergency asthma care

Audit Form for Emergency Asthma Care			
Patient Name: …….. DOB: …… Date/Time: ……			
	Yes	**No**	**N/A**
1. PEF on admission and after treatment (in anyone over 5 years)	❒	❒	❒
2. Pulse rate, respiratory rate and SpO_2. Where SpO_2< 92% check arterial blood gases and give oxygen as appropriate	❒	❒	❒
3. Inhaler technique checked and recorded	❒	❒	❒
4. Relevant past medical history recorded (asthma and atopy in particular)	❒	❒	❒
5. Triggers identified and avoidance discussed	❒	❒	❒
6. Current medicines recorded, including dose, frequency (or their absence) recorded	❒	❒	❒
7. Concordance issues addressed	❒	❒	❒
8. Psycho-social or other risk factors	❒	❒	❒
9. Stable on four hourly treatment or when PEF >75% of best or predicted	❒	❒	❒
10. Steroid tablets given as appropriate, as per GINA guidelines	❒	❒	❒
11. Provided written information and action plan	❒	❒	❒
12. Follow-up with GP within 2 working days of discharge advised for moderate/severe/life-threatening asthma (2 weeks – mild) and discharge letter sent	❒	❒	❒

Where you have ticked N/A (not applicable) please explain here e.g. No Peak flow as under 5

HOW TO USE YOUR PEAK FLOW METER

1. Measure your peak flow morning and evening **before** taking your inhalers.
2. Sit up straight.
3. Push the pointer on the peak flow meter to base/zero.
4. Take a deep breath in.
5. Grip the mouthpiece with your teeth and seal with your lips. Take care not to cover or block the pointer with your finger.
6. Blow as hard and fast as you can. (Short, sharp blast)
7. Do this 3 times and record the **highest** reading.

If you are unsure of how to use your peak flow meter go to the Asthma Society of Ireland website **www.asthmasociety.ie** for a video demonstration.

WHAT TO DO IN AN ASTHMA ATTACK

"THE FIVE MINUTE RULE"

1. Ensure the reliever is taken immediately. This is usually blue and opens up narrowed airways.
2. Sit down and loosen tight clothing.
3. Attacks may be frightening and it is important to stay calm.
4. If no immediate improvement during an attack, continue to take the reliever every minute for five minutes or until symptoms improve: two puffs of MDI/evohaler or one puff of turbohaler.
5. If your symptoms do not improve in five minutes, or if you are in doubt, **call 999 or 112 or a doctor urgently.** Continue to take reliever until help arrives or symptoms improve. **Use a spacer device if possible for maximum benefit.**

Date and Signature of Health Care Professional										

Education:

- Inhaler Technique
- Relievers & Controllers
- Peak Flow Measuring / Recording
- Asthma Self Management Plan
- Allergic Triggers
- Nasal Congestion / Medication
- Exercise
- Emergency Home Steroids
- Smoking Cessation
- **Flu Vaccine (administered by)**

Asthma Management Plan

Peak Flow Diary

THESE INSTRUCTIONS ARE GUIDELINES, REGARDLESS OF THE ADVICE IN THE PLAN, IF YOU ARE UNHAPPY ABOUT YOUR CONDITION SEEK MEDICAL HELP.

Name:

Address:

Phone:

Emergency Contact:

Relationship:

Mobile Phone:

Home Phone:

GP:

GP Contact Number:

In Emergency Go To:

Phone:

ASTHMA SOCIETY OF IRELAND

Tel: (01) 817 8886
Fax: (01) 817 8878

Asthma Advice Line
1850 44 54 64
Email: office@asthmasociety.ie
www.asthmasociety.ie

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

ASTHMA MANAGEMENT PLAN	Date you started this Diary	8/11	9/11	10/11	12/11
1. Have you had any asthma symptoms during the day (coughing, wheeze, tight chest or feeling breathless).			✓		
2. Has your asthma interfered with your usual activities (e.g. housework, climbing stairs, work or school, exercise).		✓		✓	
3. Have you had difficulty sleeping because of your asthma symptoms (including coughing)		✓			
4. Have you needed to use your reliever inhaler more than twice a week					
5. Have you had nasal symptoms (eg nasal congestion, sneezing, post nasal drip etc.)					

GREEN ZONE: ASTHMA UNDER CONTROL

- Daytime symptoms less than twice/week
- No limitation of exercise
- No waking at night due to symptoms
- Reliever medication used less than twice per week
- Peak flow between _____ and _____

Peak Flow between 80-100% of Personal Best

Your Regular Treatment. Each day take:

1. Reliever _____
2. Controller _____
3. _____
4. _____

Before Exercise take _____

BLUE ZONE: ASTHMA GETTING WORSE

- Daytime symptoms more than twice/week?
- Getting chesty cough?
- Waking at night with cough or wheeze?
- New or increased daytime cough or wheeze?
- Symptoms after activity or exercise?
- Using reliever meds more than twice per week?
- Peak flow between _____ and _____

Peak Flow between 60-80% of Personal Best

If you answered 'yes' to 3 or more of these questions, your asthma is uncontrolled and you may need to step up your treatment.

Step up your treatment as follows:

1. Increase your reliever to _____
2. Take _____

The need for repeated doses over more than 1 or 2 days signals the need for a review by your doctor.

Use a spacer device if possible for maximum benefit.

ORANGE ZONE: ASTHMA BECOMING SEVERE

- Symptoms becoming more severe
- Becoming breathless at rest
- Chest tightness
- Reliever medication has poor or short lived effect
- Peak flow between _____ and _____

Peak Flow between 40-60% of Personal Best

Call your doctor/clinic: Phone No. _____ and get immediate advice.

Take the following medication.

1. Increase your reliever use to _____
2. Additional Instructions _____
3. Take ____ mg of _____ (oral steroid) if prescribed.

Out of hours contact _____

Use a spacer device if possible for maximum benefit.

RED ZONE: EMERGENCY

- Shortness of breath
- Can only speak in short sentences
- Trouble walking
- Lips are blue
- Short lived response to reliever.
- Peak flow is less than _____

Peak Flow is less than 40% of Personal Best

Get medical help immediately.

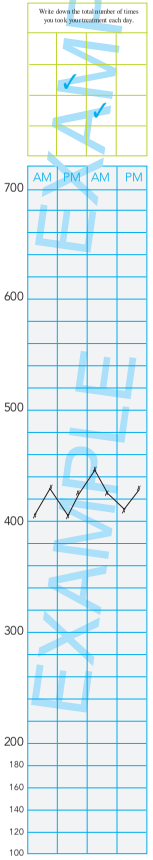
Go to _____ **Phone:** _____

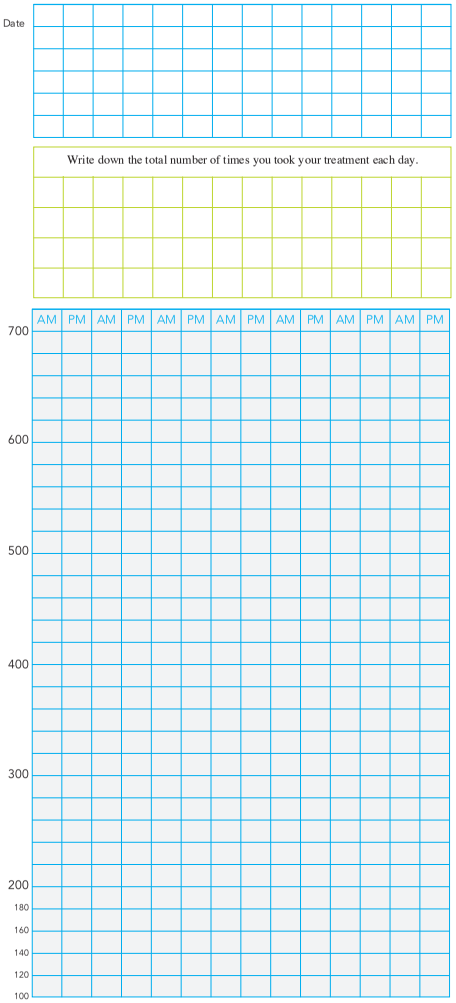
Out of Hours: _____

Take 2 to 4 puffs of your reliever inhaler

Take ____ mg of _____ (oral steroid) if prescribed.

Continue to take 2 puffs of reliever every minute until symptoms improve or help arrives.
Use a spacer device if possible for maximum benefit.



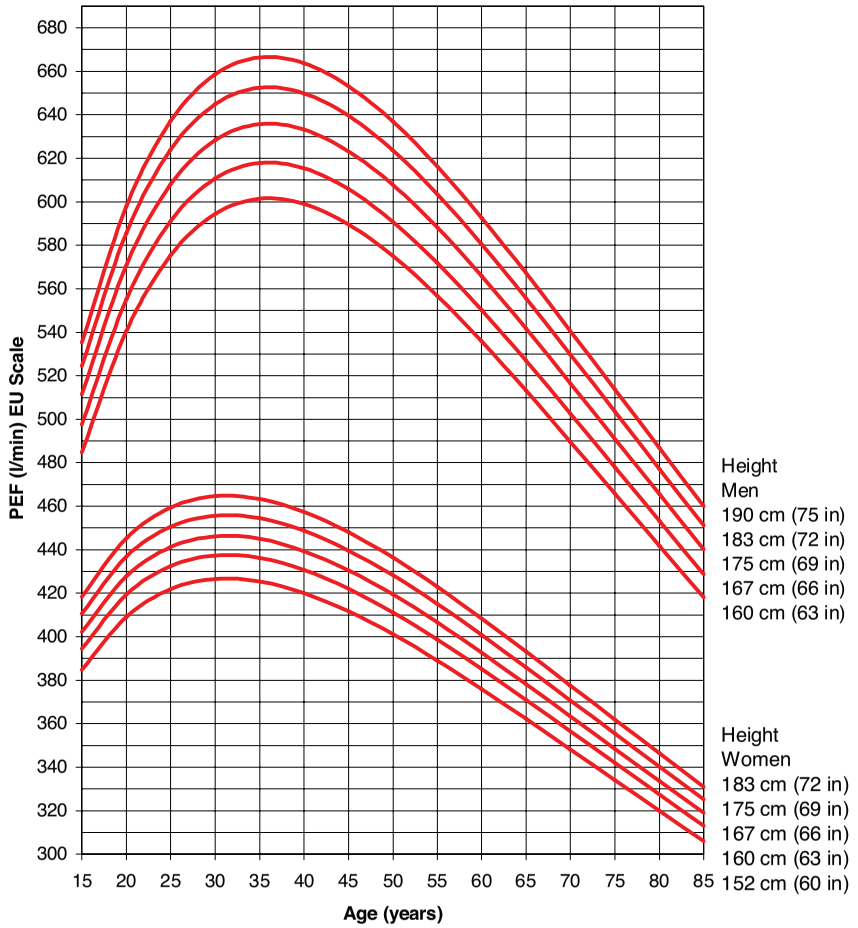


Appendix 2.6. Peak Flow Measurements

ADULT MALE NORMAL VALUES Peak Expiratory Flow Rate					
For use with EU/EN13826 scale PEF meters only					
AGE in yrs	*Height*				
	1.6m 5'3"	1.67m 5'6"	1.75m 5'9"	1.83m 6'	1.90m 6'3"
15	485	498	511	524	535
20	540	555	571	586	398
25	575	591	608	624	637
30	594	611	628	645	659
35	601	618	636	653	666
40	599	615	633	650	664
45	590	606	623	640	653
50	575	591	608	624	637
55	557	572	588	603	616
60	536	550	566	581	593
65	513	527	542	556	567
70	490	503	517	530	541
75	466	478	491	503	514
80	552	453	465	477	487
85	418	429	440	451	460

ADULT FEMALE NORMAL VALUES Peak Expiratory Flow Rate					
For use with EU/EN13826 scale PEF meters only					
AGE in yrs	*Height*				
	1.52m 5'	1.6m 5'3"	1.67m 5'6"	1.75m 5'9"	1.83m 6'
15	385	394	402	411	418
20	409	419	428	437	445
25	422	433	441	451	459
30	427	437	446	456	465
35	425	436	445	454	463
40	420	431	439	449	457
45	412	422	431	440	448
50	401	411	419	428	436
55	389	399	407	415	423
60	376	385	393	401	408
65	362	371	378	386	393
70	348	356	363	371	378
75	334	342	348	355	362
80	320	327	334	340	346
85	306	313	319	325	331

Peak Expiratory Flow Rate – Normal Values



Adapted by Clement Clarke for use with EN13826 / EU scale peak flow meters
from Nunn AJ Gregg I, Br Med J 1989:298;1068-70

Appendix 2.7. Medications in acute asthma

Medicine Class/Generic Name	Adult Dose	Comments
Oxygen	High Flow	Adults with severe asthma are hypoxaemic and should be given high flow oxygen to maintain oxygen saturation at 92% or above
β_2 agonist bronchodilators/ salbutamol, terbutaline	Ideally salbutamol 5mg or terbutaline 10mg via oxygen driven nebuliser or up to 12 puffs via spacer Repeat doses should be given at 15-30 minute intervals or continuous nebulisation of salbutamol at 5-10mg/hour if inadequate response to initial treatment	These act quickly to relieve bronchospasm and have few side effects. They should be administered as early as possible in an asthma attack. pMDI + spacer is preferable method of delivery. 12 PUFFS VIA SPACER IS JUST AS EFFECTIVE AS NEBULISER UNLESS FEATURES OF LIFE-THREATENING ASTHMA ATTACK
Bronchodilators/ Ipratropium	0.5mg 4-6 hourly mixed with nebulised β_2 agonist in severe or life threatening asthma or those with a poor initial response to β_2 agonist therapy	
Steroids/Prednisolone	40-50mg daily for 3 to 7 days or until recovery	Steroid tablets reduce mortality, relapses and hospital admissions. The earlier they are given in an attack the better the outcome. Following recovery steroid tablets can be dropped abruptly and do not need tapering provided that the patient is receiving inhaled steroids (apart from those patients on maintenance steroid tablets or where steroid tablets are needed for more than three weeks).
Steroids/Hydrocortisone	IV (100mg, 6 hourly)	ONLY USE IV IF COMATOSE OR VOMITING AS ORAL PREDNISOLONE IS JUST AS EFFECTIVE
IV Magnesium Sulphate	1.2 – 2g IV infusion over 20 minutes but should only be used following consultation with senior medical staff	Consider giving single IV dose for patients with severe asthma who have not had a good initial response to inhaled bronchodilator therapy or for life threatening or near fatal asthma attacks
IV Aminophylline	Use only after consultation with senior medical staff	
Antibiotics		Routine prescription of antibiotics is not indicated for asthma. Infection often triggers an episode but is more likely to be viral rather than bacterial in type

Appendix 3: Search Sources and Outputs

Appendix 3.1 Guideline clearing houses and organisations which develop guidelines and/or support evidence based practice; search sources and outputs

Databases/ organisation	Search Terms	Date searched	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
US National Guideline Clearinghouse www.guideline.gov	**Advanced Search** **Keyword:** acute asthma management **Age of Target Population:** Adult (19 to 44 years), Middle Age (45 to 64 years), Aged (65 to 79 years), Aged 80 and over **Publication Year:** 2011, 2012, 2013, 2014, 2015	10/04/2015	50	N=48 Reasons for exclusion Not specific to asthma Not systematic evidence based clinical guideline	N=2 One is BTS/SIGN – INCLUDE Second one is ICSI - EXCLUDE
Guidelines International Network www.g-i-n.net	**Search Guidelines** Acute adult asthma management Acute asthma management Asthma management	10/04/2015	 0 2 19	 N=0 N=1 N=14 Reasons for exclusion Not specific to asthma Child focused Not systematic evidence based clinical guideline Published before 2011	 N=0 N=1 N=5 KSUMC EBCPG 2013 – localised; adapted from BTS/ SIGN – EXCLUDE GINA – INCLUDE KSUMC EBCPG Child - EXCLUDE 3 Duplicates

Databases/ organisation	Search Terms	Date searched	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Scottish Intercollegiate Guidelines Network (www.sign.ac.uk)	Adult acute asthma management guidelines	10/04/2015	68	N=67 Reasons for exclusion COPD/RTI Not systematic evidence based clinical guideline	N=1 BTS/SIGN http://www.sign.ac.uk/guidelines/fulltext/101/index.html - Duplicate
National Institute for Health and Clinical Excellence UK (www.nice.org.uk)	**Search under GUIDANCE** Adult acute asthma management	10/04/2015	55	N=54 Reasons for exclusion Focus on inhalers only Child focus COPD Other conditions i.e. not asthma specific	N=1 Quality Standard on Asthma 2013 *(? Standard and in accordance with BTS/SIGN guidance)*- EXCLUDE
New Zealand Guideline Group (NZGG) (http://www.health.govt.nz/about-ministry/ministry-health-websites/new-zealand-guidelines-group)	Adult acute asthma management	10/04/2015	33	N=33 Reasons for exclusion Not guideline Not specific to asthma Published before 2011	N=0
Centre for Clinical Effectiveness Australia (http://www.monashhealth.org/page/CCE)	*Screened the lists of the current evidence reviews and resources (workbooks and toolkits) and other resources (NHMRC – see below)*	10/04/2015	0	N=0	N=0
National Health and Medical Research Council (NHMRC) (Australia)	**Searched: Guidelines and Publications** **Filter by subject:** asthma	10/04/2015	1	N=1 Reasons for exclusion *It was 'asthma: management, education and research' but it was dated 1995 and rescinded in 2005*	N=0

Databases/ organisation	Search Terms	Date searched	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Clinical Practice Guideline Portal (NICS) (https://www.clinicalguidelines.gov.au/)	**Search by Condition** Asthma	10/04/2015	13	N=12 Reasons for exclusion Not guideline Child focused COPD	N=1 *Web link http://www.asthmahandbook.org.au/ which brings one to Australian Asthma Handbook 2014 (and also a quick reference guide)- INCLUDE*
TRIP Database (www.tripdatabase.com) – for findings high-quality clinical research evidence	**Advanced Search** **All of these words:** adult acute asthma management (anywhere in the document) **This exact phrase:** guideline (in title only) **Start year:** 2011 **End year:** 2015	10/04/2015	200	N=196 Reasons for exclusion Not guideline Child focused Chronic asthma Not asthma focused – CPD; bronchiolitis, RTI etc.	N=4 Canadian Thoracic Society 2012 – Lougheed et al paper - INCLUDE BTS/SIGN - Duplicate Duplicate - Same one as nat. clearing house (diagnosis and management of asthma) Duplicate - One other one from nat. clearing house – Michigan Quality Improvement Consortium – principles for diagnosis and management of asthma
Outputs			**Hits 441**	**First screen - Excluded 426**	**First screen - include as potentially eligible 15** **Second screen** **Exclude 11** **Include 4 (BTS/SIGN; GINA; CTS; AUSTRALIAN HANDBOOK)**

Appendix 3.2. International asthma, thoracic and lung associations.

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Asthma Societies/ Associations					
Asthma UK http://www.asthma.org.uk/Default.aspx	Guidelines	11/4/15	58	N=55 Reasons for exclusion: Emergency asthma care booklet; helplines for asthma parents, patients	N=3 **BTS/SIGN** (2014 guidelines - INCLUDE) **ARIA** (out of date/ 2010 - EXCLUDE) **NICE** guidelines (Asthma Guidelines in Development at Present) - EXCLUDE
British Society for Allergy and Clinical Immunology (BSACI) www.bsaci.org	Asthma Guidelines	11/4/15	61	N=61 Reasons for exclusion: No asthma guidelines after 2008; Rhinitis management guidelines only	N=0
British Lung Foundation (BLF) www.blf.org.uk	Adult acute asthma guidelines	11/4/15	32	N=31 Reasons for exclusion: SIGN guideline from 2008	N=1 **NICE** (**Asthma *Standard* ONLY**) - Exclude
Asthma Society of Ireland (ASI) www.asthma.ie	"guidelines"	11/4/15	9	N= 9 Reasons for exclusion: Information for patients/ families; Mentions GINA guidelines	N=0

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
American Academy of Allergy Asthma and Immunology (AAAI) https://www.aaaai.org/home.aspx	"asthma guidelines"	11/4/15	38	N=38 Reasons for exclusion: NIH 2007 guidelines NHLBI guidelines (2007)	N=0 Education needs and practice gaps recognised- Asthma Management: a topic identified at the AAAI members meeting on the 8/10/2014
Asthma and Allergy Foundation of America (AAFA) www.aafa.org	Asthma Management	11/4/15	51	N=51 Reasons for exclusion: No clinical guidelines Refers to NAEPP panel 3 guidelines (2007)	N=0
National Heart, Lung and Blood Institute (NHLBI) www.nhlbi.nih.gov	"asthma management"	11/4/15	192	N=191 Reasons for exclusion: Out of Date Clinical Guidelines (2007) Guidelines for families	N=1 **NHLBAC** Asthma *Report* (2014) (**Not to be included as NOT a Guideline**) – Exclude
National Institute of Allergy and Infectious Diseases (NIAID) www.niaid.nih.gov	"asthma guidelines"	11/4/15	4	N=3 Reasons for exclusion: Development of guidelines Guidelines for food allergy with asthma Council minutes from meeting for asthma guidelines	N=1 **NHLBI/NAEPP** guidelines for asthma (2014) (**Not to be included- NOT Guidelines: *REPORT* only**) – Exclude
Association of Asthma Educators (AAE) www.asthmaeducators.org	Asthma Management	11/4/15	15	N=15 Reasons for exclusion: Site only for courses for educating health professionals asthma management	N=0
Centres for Disease Control and Prevention (CDC) www.cdc.gov	No Search Window Click: **Diseases and Conditions** Click: **Asthma** Click: **Health Care Professionals**	11/4/15	1	N=0	N= 1 **NHLBI** Guidelines (2014) (**NOT to be included-*Report ONLY***) - Exclude

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
National Asthma Education and Prevention Program (NAEPP) www.nhlbi.nih.gov/about/org/naepp	"asthma management"	11/4/15	192	N=191 Reasons for exclusion: Self-management guidelines; guidelines for patients and families; fact book	N=1 ***NHLBAC report*** (2014) - Exclude
Canadian Society of Respiratory Therapists (CSRT) www.csrt.com	Asthma Guidelines	12/4/15	1	N=0	N=1 Hyperlink to **GINA** website - Duplicate
Asthma Society of Canada (ASC) www.asthma.ca	"asthma management"	12/4/15	34	N=33 Reasons for exclusion: Asthma videos; asthma action plans; news releases; health index; asthma control guide; COPD guidelines using CTS guidelines	N=1 **GINA** guidelines (2014) – there is 2015 version available
Allergy and Asthma Information Association (AAIA) www.aaia.ca	**Advanced Search:** **All Words:** Adult acute asthma guidelines **Any of these Words**: Adult acute asthma guidelines **None of These Words**: Children **Show**: 25 **result per page** **Description Text:** Normal **Word Stemming**: Automatic	12/4/15	2	N=2 Reasons for exclusion: Anaphylaxis Guidelines for Schools; Guidelines in French	**Click**: Information about Asthma **Click**: Asthma Consensus Guidelines update 2003= ***Refers to CTS guidelines*** for Adult Group
European Federation of Asthma and Allergy Associations (EFA) www.efanet.org	Adult asthma guidelines	11/4/15	8	N=8 Reasons for exclusion: All newsletters ARIA mentioned in a newsletter	N=0
European Academy of Allergy and Clinical Immunology (EAACI) www.eaaci.org	Asthma guidelines	11/4/15	20	N=20 Reasons for exclusion: Paediatric asthma guidelines; Position statements	N=0

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
European Lung Foundation (ELF) www.europeanlung.org	Asthma management	11/4/15	17	N=15 Reasons for exclusion: Occupational; risk factors of asthma; air pollution and asthma	N=2 Newsletters suggest treating asthma based on ***ERS/ATS guidelines – Exclude***
European Respiratory Society (ERS) www.ersnet.org	Asthma management	11/4/15	31	N=29 Reasons for exclusion: Journals; world asthma day;	N=2 • **GINA** (2014); - Duplicate • Publication includes **ERS/ATS - Exclude**
Asthma New Zealand www.asthma-nz.org.nz	Asthma Management	11/4/15	9	N=9 Reasons for exclusion: Adult asthma management plan; COPD management; Asthma Management Nursing Course	N=0
The Asthma Foundation www.asthmafoundation.org.nz	Adult acute asthma guidelines	11/4/15	1	N=1 Reasons for exclusion: "seeking support to update guidelines" 2002 guidelines only	Recommended: • **BTS/SIGN** • **GINA** guidelines (*until website has the updated guidelines in place*)
Asthma Australia www.asthmaustralia.org.au	**Click**: Health Professionals **Click**: Health Professionals Resources	11/4/15	1	N=0	N=1 **GINA** Guidelines (2014)
National Asthma Council Australia www.nationalasthma.org.au	Adult Acute Asthma Guidelines	11/4/15	114	N=113 Reasons for exclusion: 2014 Asthma Management Handbook- not guidelines	N=1 Asthma Booklet ??PDF Availability (contact emailed)
Australia Medical Association www.ama.com.au	"asthma management"	11/4/15	19	N=19 Reasons for exclusion: 2014 Asthma handbook for GP use; Asthma management plan; Asthma treatment	N=0

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
GINA - Global Information Network on Asthma (GINA) www.ginasthma.org	Asthma management	11/4/15	87	N=85 Reasons for exclusion: 2015 pocket guide Children's pocket guide	N=2 • **GINA** 2012 guideline • **GINA** 2015 (global strategy for management and prevention)
World Allergy Organization (WAO) www.worldalergy.org	"asthma management"	11/4/15	118	N=118 Reasons for exclusion: GINA 2002; NAEPP 1997; Journals not guidelines (GINA guidelines mentioned); 2011 WAO White Book on Allergies	N= 0
World Health Organisation (WHO) www.who.int/en	"asthma management"	12/4/15	30	N=30 Reasons for exclusion: GARD reports out of date (2004/2005); Tobacco Control Guideline	N=0
International Primary Care Respiratory Group (IPCRG) www.theipcrg.org	Adult Acute Asthma Guidelines	12/4/15	58	N=58 All journal publications however; GINA/NICE/BTS mentioned in same BTS/SIGN mentioned for children guidelines	N=0
Global Allergy and Asthma Patient Platform(GAAPP) www.ga2p2.org	No Search Box **Click**: Links **Click**: Guideline Organizations	12/4/15	2	N= 0	N=2 • **GINA** 2014 • **ARIA** 2008 (OUT OF DATE)
Allergic Rhinitis and it Impact on Asthma (ARIA) www.whair.org	No Search Box **Click**: ARIA guidelines	12/4/15	1	N=1 2008 ARIA pocket guide	N=0 (OUT OF DATE)

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Global Alliance Against Chronic Respiratory Disease (GARD) www.who.int/resp/gard/en	Adult Acute Asthma Guidelines	12/4/15	203	N=203 GARD 'basket' Guidelines Document (2008)	N=0 (OUT OF DATE)
Thoracic Societies					
British Thoracic Society (BTS) https://www.brit-thoracic.org.uk/	Adult acute asthma guidelines	11/4/15	25	N=18 Reasons for exclusion: Advisory groups only Guidelines on pneumonia/ TB	N=7 • **NICE** standards • Adult Asthma Audit 2012 • **BTS/SIGN** Guidelines • **ARIA** guidelines (OUT OF DATE)
American Thoracic Society (ATS) http://www.thoracic.org/	Adult asthma guidelines 2015	11/04/15	292	N= 291 Reasons for exclusion: journals only- Guidelines mentioned in journals are: ERS/ATS	N=1 Journal includes discussion with reference to: **ERS/ATS** guidelines
Canadian Thoracic Society/ Respiratory Guidelines (CTS) www.respiratoryguidelines.ca	Asthma Management	12/4/15	11	N=10 Reasons for exclusion: Journal references only; Professional development courses for asthma management	N=1 **GINA** guidelines
Irish Thoracic Society (ITS) www.irishthoracicsociety.com	No Search Box	11/4/15	None	ITS report on Home Page (2008)	N=0
Scottish Thoracic Society (STS) www.sts.rcpe.ac.uk	Adult acute asthma guidelines	11/4/15	5	N=5 Reasons for exclusion: No guidelines However, ATS/BLF/BTS/ ERS all mentioned	N=0
The Thoracic Society of Australia and New Zealand	Adult acute asthma guidelines	11/4/15	69	N=69 2006 guidelines only 2006 handbook	N=0 (OUT OF DATE)

Organisations	Search Term	Date of search	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Lung Associations					
American Lung Association (ALA) http://www.lung.org/lung-disease/	Clinical Practice Adult Asthma Guidelines	11/4/15	77	N=76 Reasons for exclusion: Address topics of importance relating to asthma care (i.e. Tobacco control) State by State Asthma Action Plans No Clinical Guidelines evident	N=1 Reasons: Alaska Asthma Plan 2006-2011 includes reference to **GINA/ NHLBI** guidelines (2014)
The Lung Association Ontario www.on.lung.ca	"asthma management"	12/4/15	20	N= 19 Reasons for exclusion: School provider education program for asthma management Asthma Handbook Asthma Action Plans for parents	N=1 Emergency Department Asthma Care Pathway (EDACP) March 2013- Bases the pathway on **CTS** guidelines
The Lung Association www.lung.ca	Asthma Management	12/4/15	16	N=15 Reasons for exclusion: Asthma action plans; asthma education; asthma at work; asthma and spirometry	N=1 **GINA** guideline (2014)
Outputs			Hits 1924	Exclude 1892	Potentially eligible (first screen = 32 Second Screen Exclude 29 Include 3 (SIGN/BTS; GINA; AUSTRALIAN HANDBOOK)

Appendix 3.3 Grey literature databases

Grey Literature Databases	Search Terms	Dates	Hits	Screen for eligibility EXCLUDE	Screen for eligibility INCLUDE
Agency for Healthcare Research and Quality http://www.ahrq.gov/	**Advanced Search** **With all the words**: adult acute asthma management **With the exact phrase**: "guideline" **Limited** to English language and filetype:pdf **Return results where terms appear anywhere in the page** *Click on Health care information – topics A-Z – topic asthma – for professionals*	10/04/2015	N=261	N=261 Reasons for exclusion – same Quality improvement as opposed to a guideline	N=0
Open Grey http://www.opengrey.eu/	Asthma guidelines Adult acute asthma +guidelines	10/04/2015	N=11 N=4	N=11 N=4	N=0 N=0
Outputs			Hits 276	Exclude 276	Include 0

Appendix 3.4. Electronic databases

ID	Search terms	Medline	CINAHL	PUBMED
#1	Asthma (MH+)	107,073	24627	107092
#2	Asthma (keyword)	143,572	28506	140458
#3	Acute asthma (keyword)	2932	785	2932
#4	Acute asthma exacerbations (keyword)	255	88	255
#5	Uncontrolled asthma (keyword)	602	136	602
#6	Severe asthma (keyword)	5187	966	5182
#7	Life threatening asthma (keyword)	194	57	192
#8	Near fatal asthma (keyword)	181	36	181
#9	Status asthmaticus (MH)	1040	225	1684
#10	**OR/#1-9**	**143837**	**28616**	**140811**
#11	adult (MH+)	5665024	1145736	5667848
#12	Adult (keyword)	4444059	776697	4439961
#13	Adult patient (keyword)	4591	876	4593
#14	**OR/#11-13**	**6015758**	**1171670**	**6012229**
#15	Assessment (keyword)	922294	346611	914280
#16	Monitoring (keyword)	459208	69398	456690
#17	Diagnosis (MH+)	6610890	1121029	6612465
#18	Treatment (keyword)	3506610	521017	3498250
#19	Management	917757 (KW)	9978 (MH)	875672 (tw)
#20	Inhalers (keyword)	3475	678	3475
#21	Pharmacological management (kw)	1621	547	1620
#22	Non-pharmacological management	163	67	0
#23	Self-management (kw)	9718	6002	9636
#24	Control (kw)	3010710	608387	2959051
#25	Quality of life (MH)	122714	62463	122760
#26	Self-care (MH)	24236	24372	40854
#27	Morbidity (MH)	23524	5683	383046
#28	Mortality (MH)	34519	17348	288028
#29	**OR/#15-28**	**11310825**	**1842154**	**11434890**
#30	Hospitalization (MH +)	164757	62705	164805
#31	Patient admission (MH)	18979	10840	18982
#32	Patient discharge (MH)	19637	10395	19647
#33	Acute adult hospital (kw)	3	2	0
#34	Emergency medicine (MH)	10153	7367	10153
#35	Emergency medical services (MH +)	98675	66913	98725
#36	Emergency Service, Hospital	51482 (MH+)	2 (kw)	51517
#37	Primary health care	82009 (MH+)	40805 (MH)	82048
#38	Primary care (kw)	91294	37157	77262
#39	General practitioners	2318 (MH)	7074 (kw)	2319 (MH)
#40	Family practice (MH)	60116	18355	60116
#41	Physicians, family	14773	12163	14733
#42	Allied health personnel (MH +)	42381	84759	42385

ID	Search terms	Medline	CINAHL	PUBMED
#43	Emergency medical technicians (MH)	4909	8577	4909
#44	**OR/#30-43**	**481679**	**302166**	**462294**
#45	AND/10+14+29+44	2845	1105	2848
	Limiters			
		2627 (eng language)		576 (dates applied)
	Note: These were all screened from here down.	558 (date and language)	345 (date and language limiters applied)	541 (English language)
	Limiter - guideline	0	2	1
		0	0	0

Appendix 3.5 Internet search engines

Internet search engine	Search Term	Date of search	Screened	Outputs
Google	**Advanced Search** **All these words:** asthma management in adults **This exact word or phrase:** "guideline" **Limited to**: English language and file type pdf	11/04/2015	First 10 pages n=100 pdf files	New York State Dept. of Health Guidelines *(exclude – not a national guideline)* NICE Asthma Quality Standard – 2015 Consultation document *[?standard as opposed to an evidence based guideline exclude]* NHLBI Asthma Care Quick Reference 2012 *[relates to NHLBI 2007 guideline which is outside our inclusion date and this is not a specific guideline]* Japanese Guideline for adult asthma 2014 published paper *[limited methodological information authors emailed]* *SINA (Saudi Initiative for Asthma)*
Bing	("adult asthma management") ("guideline") (file type: pdf) **Narrowed:** English language	11/04/2015	First 10 pages n=100 pdf files	No guidelines retrieved that did not already have
Yahoo/Alta Vista	("guidelines for management of asthma") (pdf)	11/04/2015	First 10 pages n=100 pdf files	South African Asthma Guideline 2013 *(based on GINA – exclude)*
Outputs			**Hits reviewed n=300**	**First Screen** **Exclude 294** **Potentially eligible 6** **Second Screen** **Exclude 6** **[but waiting for Japanese – authors response]**

Points to note about the internet search engine searches

- Various combination of search terms etc. were tried before settled on the search terms, as outlined above. These search terms were populating the best results in terms of retrieving guidelines.
- If available, these searches were all narrowed to the English language and limited to the file type pdf, so as to make the search / screening manageable.
- As large volumes of data return through search engine searches screening was managed by screening the first 10 pages (i.e. 100 pdf files on each internet search engine);
- These internet searches were completed after all other searches and essentially we were looking for any guidelines that we had not already retrieved to other sources. The valuable aspect of these internet searches were that we were getting back all the guidelines which we had already sourced and the majority of these were coming up in the first 10-20 hits.
- What we noted from these searches was that the most relevant *national* guidelines were coming up in the first 10-20 hits after this the next few papers moved into more local guidelines (as opposed to national) many of which drew on the recommendations of the national retrieved guidelines.
- Reasons for exclusion – chronic asthma, occupational asthma, not national guideline, not systematic evidence based guideline, published outside inclusion criteria publication date.

Appendix 4: Characteristics of retrieved guidelines

Title/Reference	Publisher	Country, language	Publication date	End of search date	Comments
Asthma: diagnosis and monitoring of asthma in adults, children and young people	NICE National Institute for Health and Care Excellence	UK, English	Draft consult Jan 2015		Is this a standard as opposed to a guideline? It is also just a draft for consultation **EXCLUDE**
Australian Asthma Handbook 2014 http://www.asthmahandbook.org.au/	National Asthma Council Australia	Australia English	Updated April 2015 (minor update to version March 2014) First Published 1990	TBC – site states search information to follow	INCLUDE?? *Association emailed to try get pdf version…..* *Follow up – missing data; plus also limited data on 'acute' asthma* **EXCLUDE**
Clinical Guideline for the Diagnosis, Evaluation and Management of Adults and Children with Asthma.	New York State Dept. of Health		Updated July 2013		Not a national guideline No reporting of systematic methodology/evidence **EXCLUDE**
Consensus Statement for the diagnosis and management of asthma *(Lougheed MD, Lemiere C, Ducharme FM, Licskai C, Dell SD, Rowe BH, itzgerald M, Leigh R, Watson W, Louis-Philippe B, Canadian Thoracic Society Asthma Clinical Assembly. Can Respir J. 2012. 19(2):127-164)*	Canadian Thoracic Society	Canada, English	Updated 2012 First published 2010	June 2010 (for literature) Oct 2010 (for systematic reviews)	This is a published paper on the update of 4 key questions; literature search ended 2010 INCLUDE? Following discussion with GDG – this more focused on chronic asthma not 'acute' **EXCLUDE**

Title/Reference	Publisher	Country, language	Publication date	End of search date	Comments
Diagnosis and Management of Asthma (Sveum R, Bergstrom J, Brottman G, Hanson M, Heiman M, Johns K, Malkiewicz J, Manney S, Moyer L, Myers C, Myers N, O'Brien M, Rethwill M, Schaefer K, Uden D. Institute for Clinical Systems Improvement. Diagnosis and Management of Asthma. Updated July 2012)	ICSI Institute for Clinical Systems Improvement	Bloomington, Minnesota English	Updated 2012 First published 1994	Nov 2011 (for systematic reviews) March 2012 (for patient education and self-management)	Not a national guideline **EXCLUDE**
Guidelines for the Diagnosis and Management of Asthma (EPR-3)	National Heart, Lung and Blood Institute	US, English	July 2007		Outside of our inclusion criteria for publication date EXCLUDE
Guideline for the management of acute asthma in adults (South African Medical Journal March 2013: 102(3):190-198)	South African Thoracic Society	South Africa English	Updated 2013 First published 1994		These guidelines are based on GINA **EXCLUDE**
Global Strategy for Asthma Management and Prevention **(From the Global Strategy for Asthma Management and Prevention,** Global Initiative for Asthma (GINA) 2015. Available from: http://www.ginasthma.org/)	Global Initiative for Asthma (GINA)	International English	Updated 2015 First published 2002	Routine twice yearly review of literature by GINA scientific committee *(publication Jan 1to June 30 reviewed at ERS meeting and July 1-Dec 30 at ATS meeting)*	**INCLUDE**

Title/Reference	Publisher	Country, language	Publication date	End of search date	Comments
General principles for the diagnosis and management of asthma *(Michigan Quality Improvement Consortium. General principles for the diagnosis and management of asthma. Southfield (MI): Michigan Quality Improvement Consortium; 2012 Jul. 1 p.) http://www.guideline.gov/content.aspx?id=38693*	Michigan Quality Improvement Consortium	Michigan, US English	Updated 2012	2012	Not a national guideline **EXCLUDE**
International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma **(Chung et al. 2014 Eur Respir J 43:343-373)**	ERS/ATS European Respiratory Society/American Thoracic Society	International English	Published 2014		Not acute asthma (confirmed with P Manning) **EXCLUDE**
Japanese Guideline for Adult Asthma 2014 *(Allergology International 2014; 63:293-333)*	Japanese Society of Allergology	Japan English publication	Updated 2014		Limited information on methodology in terms of guideline development and grading of evidence – authors emailed (response awaited) **EXCLUDE**
Quality Standard for Asthma	NICE National Institute for Health and Care Excellence	UK, English	Last modified Feb 2013		Is this a standard as opposed to a guideline? Also standards seem to be informed/underpinned by BTS/SIGN asthma guideline **EXCLUDE**

Title/Reference	Publisher	Country, language	Publication date	End of search date	Comments
Saudi Initiative for asthma – 2012 update: guidelines for the diagnosis and management of asthma in adults and children *(Al-Moamary et al. 2012. Annals of Thoracic Medicine. 7(4):175-204)*	Saudi Initiative for Asthma (SINA)	Saudi, English	Updated 2012	*The paper states that the updated guidelines followed the same methodology as the original guidelines*	This guideline is based on other guidelines – GINA and NAEPP **EXCLUDE**
SIGN 141. British guideline on the management of asthma: a national clinical guideline.	SIGN/BTA Scottish Intercollegiate Guideline Network/ British Thoracic Society	Britain, English	Updated 2014 First published 2003	Searches conducted on a rolling basis. Diagnosis in adults (Feb 2010); non-pharmacological management (Feb 2006); pharmacological management (Feb 2010); inhaler devices (Jun 2008); management of acute asthma (June 2008); asthma in pregnancy (June 2008); patient education and self-management (Feb 2006)	**INCLUDE**

Appendix 5: Sample – AGREE II Instrument

Partial Extract - AGREE II Instrument (Brouwers et al. 2010 (12))

DOMAIN 1. SCOPE AND PURPOSE						
1. The overall objective(s) of the guideline is (are) specifically described.						
1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Comments						
2. The health question(s) covered by the guideline is (are) specifically described.						
1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Comments						
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.						
1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Comments						

DOMAIN 2. STAKEHOLDER INVOLVEMENT						
4. The guideline development group includes individuals from all relevant professional groups.						
1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Comments						
5. The views and preferences of the target population (patients, public, etc.) have been sought.						
1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Comments						

Appendix 6: Protocol for guideline appraisal training phase

Guideline review: adult acute asthma management
Strand 2: Assessment of Guideline Quality

Phase (a) Guideline Appraisal Training

PROTOCOL

Prepared by Dr Veronica Lambert DCU

The Guideline for Appraisal is……

* The guideline for conduct of the appraisal training phase (pilot) is the
* **British guideline on the management of asthma (SIGN/BTA 2014)**
* We will circulate a hard copy of the main SIGN/BTA guideline document *[and make it available through our shared folder in Google Drive]*; **however**……
* You will also need to review the electronic version which is available at the following link
* http://www.sign.ac.uk/guidelines/fulltext/141/index.html
* **This is important for accessing supplemental information such as search strategies and evidence tables; which are not always published in the main guideline document**

The Guideline Appraisal tool is… AGREE II

* We will circulate a hard copy of AGREE II MANUAL *[and make it available on our shared folder in Google Drive]*
* The Manual can also be accessed through the following link http://www.agreetrust.org/

Who are the Reviewers?……

* The AGREE II instructions recommends at least 2 but preferably 4 reviewers
* In line with this and as per tender document we propose that we have 4 reviewers to increase the reliability of the assessment
* 2 DCU reviewers = V Lambert & A Matthews
* 2 Asthma GDG reviewers = P Manning & S Lane (TBC)

What are our timelines?.....

* The timeline for completion of this training appraisal (pilot) of the SIGN/BTA guideline is **1 week;** all reviewers must submit their appraisal of the SIGN/BTA guideline to Veronica on/before close of business on **Wednesday 22nd April**
* *Following this, in week 3 (22nd-29th April), the appraisals of the remaining 3 guidelines considered as eligible for inclusion in the review must be completed by the reviewers on/before close of business on Wednesday 29th April*

What is the time commitment required to complete the training appraisal?……

* Drawing on the AGREE II training tools it is suggested that at **minimum 2-2.5 hours** should be factored in to complete the entire appraisal of the SIGN/BTA guideline.
* It is important to factor in time for the following elements;
  * **Reading the entire SIGN/BTA guideline document**
  * **Participation in online training** (details to follow on next slide)
  * **Reading of the AGREE II Manual**
  * **Completion of the guideline document appraisal**
  * *Note: some of these tasks may be conducted concurrently such as participating in online training and reading the manual; and the appraisal could be done in steps according to the domains of the AGREE II Instrument if time needed to be broken up*
    * *Note: This time will also need to be factored in for appraising the other 3 guidelines in week 3 (22nd-29th April); the time per evaluating each document might be slightly less due to familiarity with the appraisal tool/process following the training appraisal* ***e.g. 1-1.5 hours per each guideline (i.e. 3-4.5 hours for the final 3 guideline documents)***

STEP 1…. Read the guideline

* Read the SIGN/BTA clinical practice guideline document in full and obtain all related information and needed documents before undertaking the AGREE II assessment

Step 2… Participate in online training

* Alongside the **AGREE II User's Instruction Manual** *(referred to earlier and circulated)*, AGREE II have a number of online training tools; accessible @ http://www.agreetrust.org/resource-centre/agree-ii-training-tools/
  * AGREE II overview tutorial (10mins)
  * AGREE II tutorial and practical exercise (1 hour – note this is a practice exercise in appraising a guideline and could be used as an additional resource should you feel you need to do a trial run before you appraise the SIGN/BTS guideline)

STEP 3….Read the AGREE II Manual

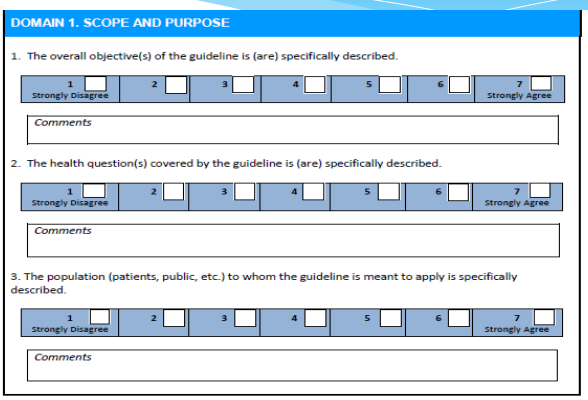
* After completing the online training you should be somewhat familiar with the AGREE II Instrument
* Following this, use the User's Manual to help you as you complete the guideline appraisal
* Hopefully the next few slides will help you with this and guide you to the relevant resources; and what exactly you need to become familiar with; including
  * The core **DOMAINS** and **OVERALL ASSESSMENT** items of the AGREE II instrument
  * The AGREE II - **RATING SCALE** (and what this means)

The AGREE II includes……
6 Domains & 2 Overall Assessment Ratings

* 23 core items …..
* 2 global rating items (i.e. overall assessment)……
* **23 items in 6 domains (User's Manual page 10 overview)**

No	Domain	No. of items	Manual page
1	**Scope and Purpose**	3	p.14-17
2	**Stakeholder Involvement**	3	p.18-21
3	**Rigour of Development**	8	p.22-30
4	**Clarity of Presentation**	4	p.31-34
5	**Applicability**	3	p.35-39
6	**Editorial Independence**	2	p.40-42
	OVERALL GUIDELINE ASSESSMENT	2	P.43-44

Example: Domain 1 Scope and Purpose



DOMAIN 1. SCOPE AND PURPOSE

1. The overall objective(s) of the guideline is (are) specifically described.

1 Strongly Disagree | 2 | 3 | 4 | 5 | 6 | 7 Strongly Agree

Comments

2. The health question(s) covered by the guideline is (are) specifically described.

1 Strongly Disagree | 2 | 3 | 4 | 5 | 6 | 7 Strongly Agree

Comments

3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.

1 Strongly Disagree | 2 | 3 | 4 | 5 | 6 | 7 Strongly Agree

Comments

Overall Guideline Assessment

* The overall assessment requires the you to make a judgment as to the quality of the guideline, taking into account the criteria considered in the assessment process
* You are also asked whether you recommend use of the guideline

Overall Guideline Assessment

OVERALL GUIDELINE ASSESSMENT

For each question, please choose the response which best characterizes the guideline assessed:

1. Rate the overall quality of this guideline.

1 ☐ Lowest possible quality	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐ Highest possible quality

2. I would recommend this guideline for use.

YES	☐
YES, With modifications	☐
NO	☐

NOTES

THE *7-point* RATING SCALE

- **All AGREE II items are rated on the following 7-point scale**

1 ☐ Strongly Disagree	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐ Strongly Agree

Score	Meaning
7 (strongly agree)	The quality of reporting is exceptional **Full CRITERIA** and **CONSIDERATIONS** are met *(see User's Manual on 'HOW TO RATE' p. 11 & slide to follow)*
1 (strongly disagree)	No information relevant to AGREE II item OR the concept is very poorly reported
2-6	The reporting of the item does not meet the full CRITERIA or CONSIDERATIONS, depending on the completeness and quality of reporting. Scores increase as more criteria are met and considerations addressed.

For each Domain there is guidance for rating the 23 items……

You will need to follow the User's Manual pages 11-41

First **READ PAGE 11 of the User's Manual** which gives you details on **3 additional sections** to facilitate your assessment

- **User's Manual Description**
  - (i.e. this section defines the item concept and provides examples)
- **Where to Look**
  - (i.e. this section directs the appraiser to where the information to rate the item might be found in the guideline document)
- **How to Rate**
  - (i.e. this sections gives details on the assessment CRITERIA and CONSIDERATIONS specific to each item)
    - **CRITERIA** – reflect the operational definition of the item; the more criteria that are met the higher the rating for that item
    - **CONSIDERATIONS** – are to help inform the assessment; the more criteria that are met the higher the rating for that item

SCOPE AND PURPOSE

1. The overall objective(s) of the guideline is (are) specifically described.

* Example of
  - **User's Manual Description**
  - **Where to Look**
  - **How to Rate**
* For item 1 Domain 1 (scope and purpose)
* (p.15 AGREE II User's Manual)

User's Manual Description:

This deals with the potential health impact of a guideline on society and populations of patients or individuals. The overall objective(s) of the guideline should be described in detail and the expected health benefits from the guideline should be specific to the clinical problem or health topic. For example, specific statements would be:

- Preventing (long term) complications of patients with diabetes mellitus
- Lowering the risk of subsequent vascular events in patients with previous myocardial infarction
- Most effective population-based colorectal screening strategies
- Providing guidance on the most effective therapeutic treatment and management of patients with diabetes mellitus.

Where to Look:

Examine the opening paragraphs/chapters for a description of the scope and purpose of the guideline. In some cases, the rationale or need for the guideline is described in a document separate from the guideline, for instance, in the guideline proposal. Examples of commonly labeled sections or chapters in a guideline where this information can be found include: introduction, scope, purpose, rationale, background, and objectives.

How to Rate:

Item content includes the following *CRITERIA*:

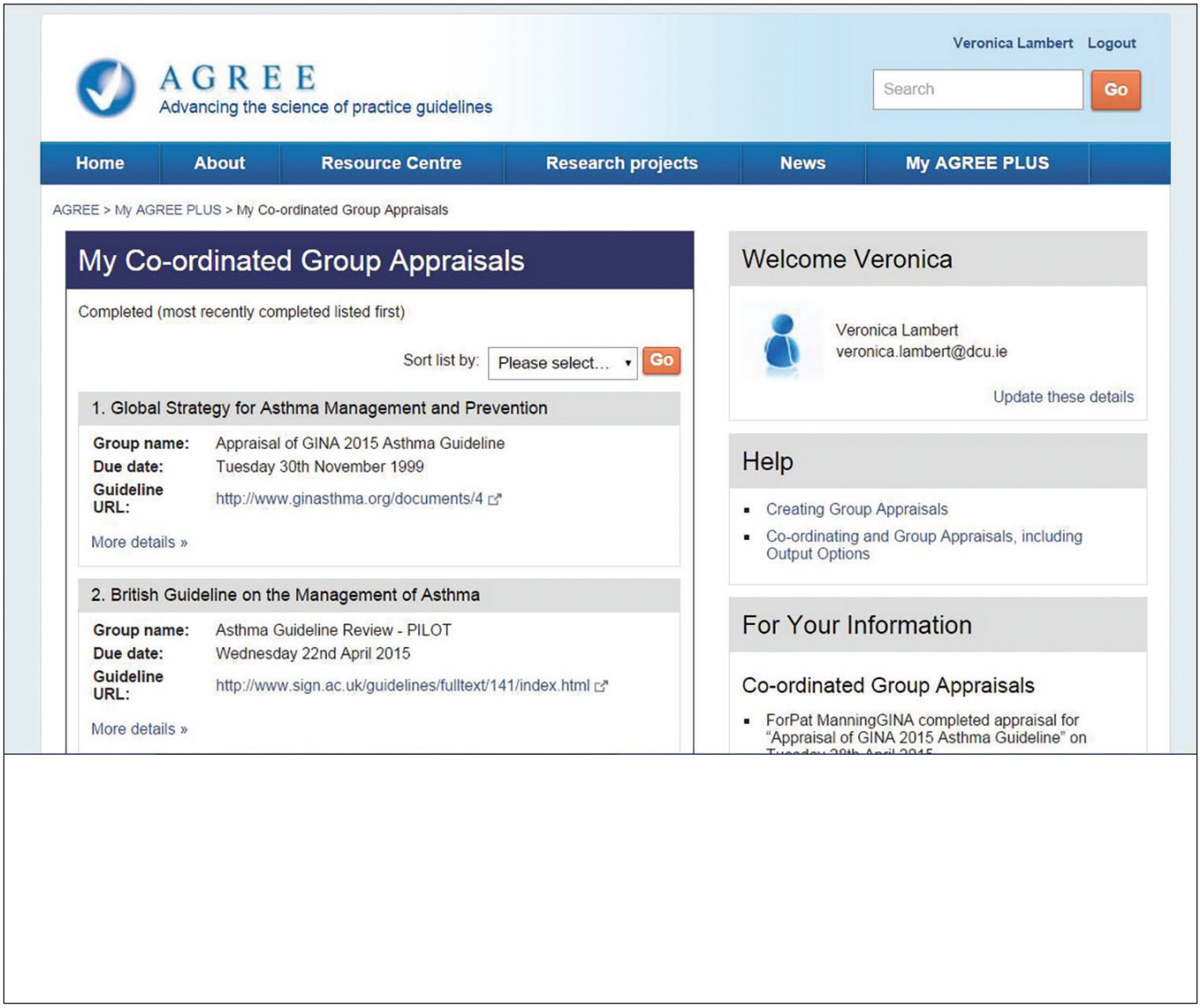
- health intent(s) (i.e., prevention, screening, diagnosis, treatment, etc.)
- expected benefit or outcome
- target(s) (e.g., patient population, society)

Additional *CONSIDERATIONS*:

- Is the item well written? Are the descriptions clear and concise?
- Is the item content easy to find in the guideline?

Appendix 7: MY AGREE PLUS

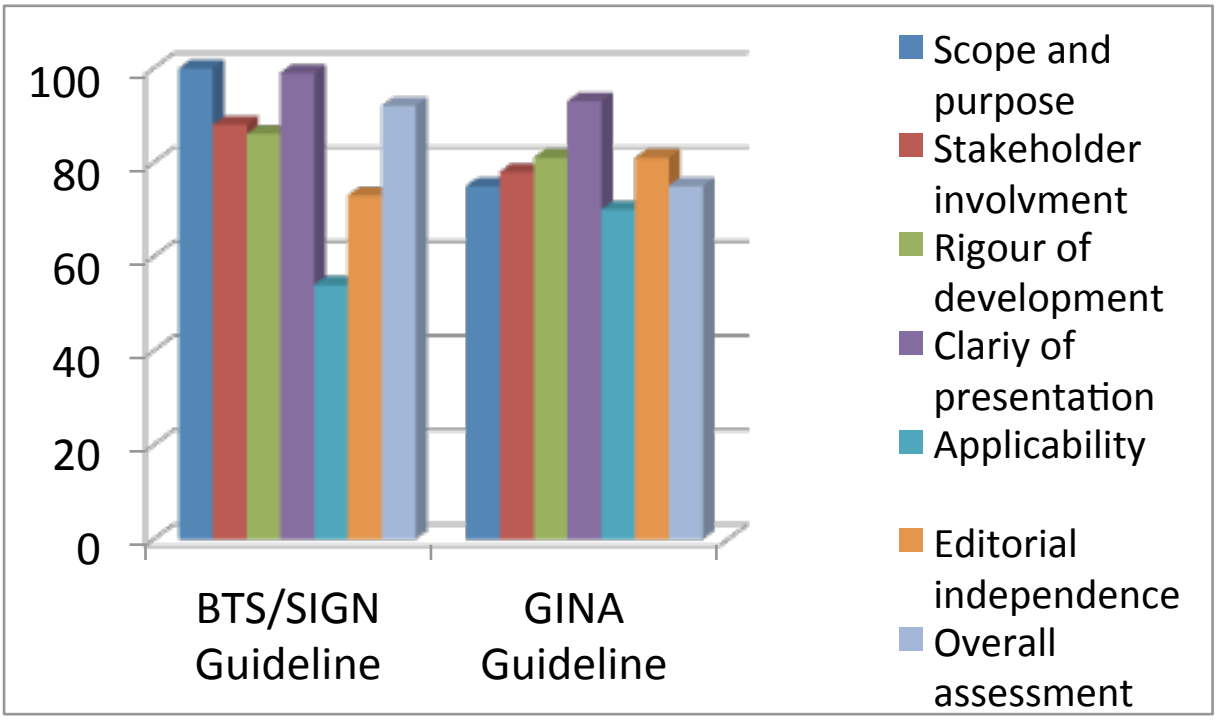
http://www.agreetrust.org/



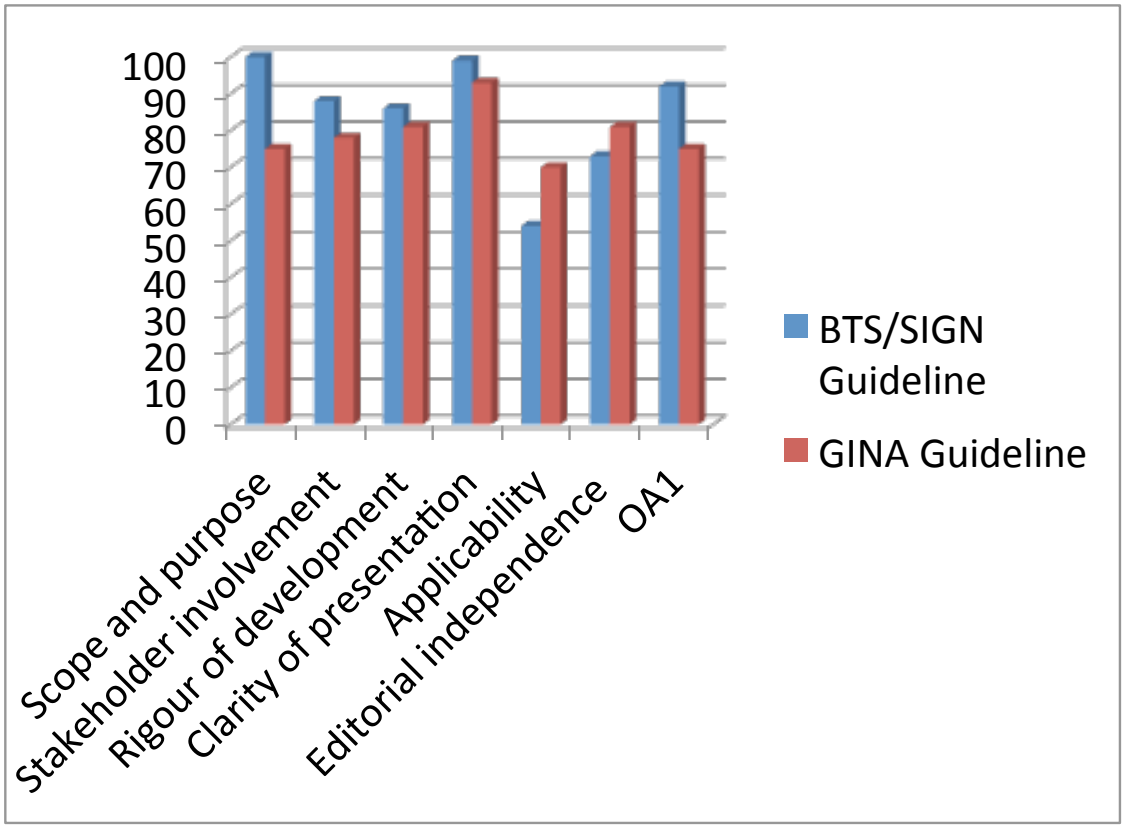
Appendix 8: Quality appraisal visual graphs

(overall scores and inter-rater agreement)

Domains – overview – both guidelines

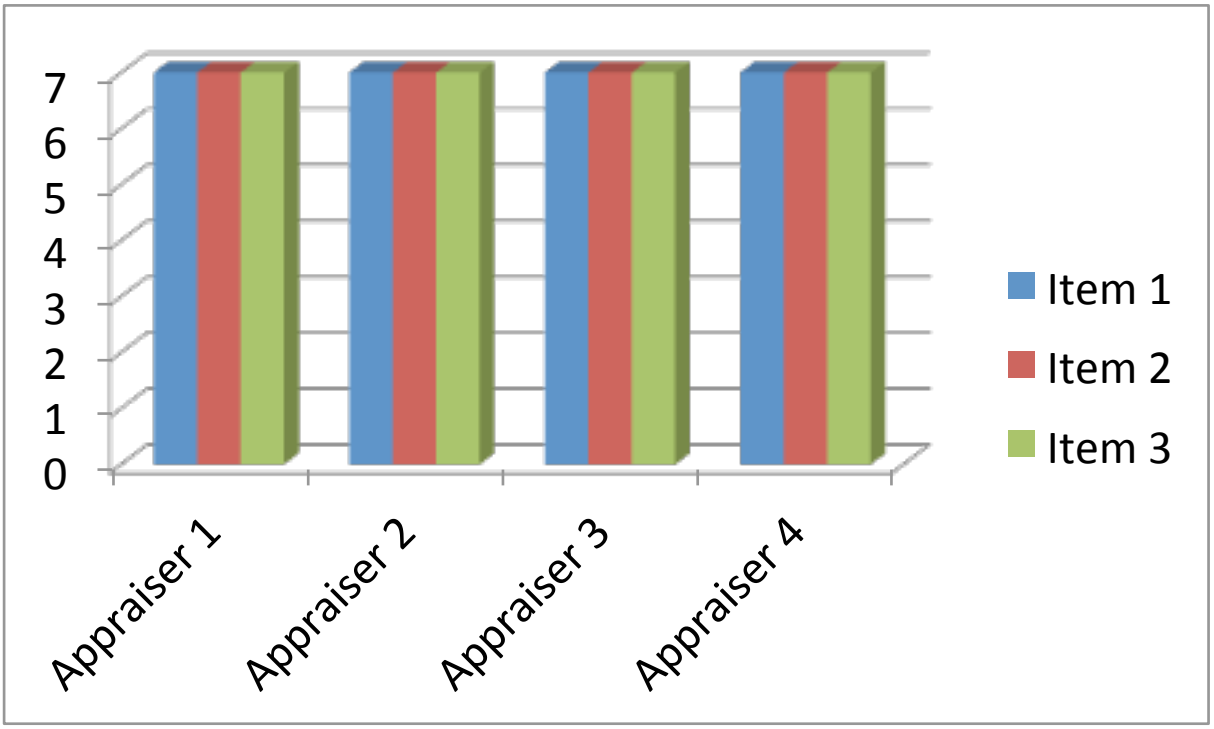


Domains – overview – both guidelines

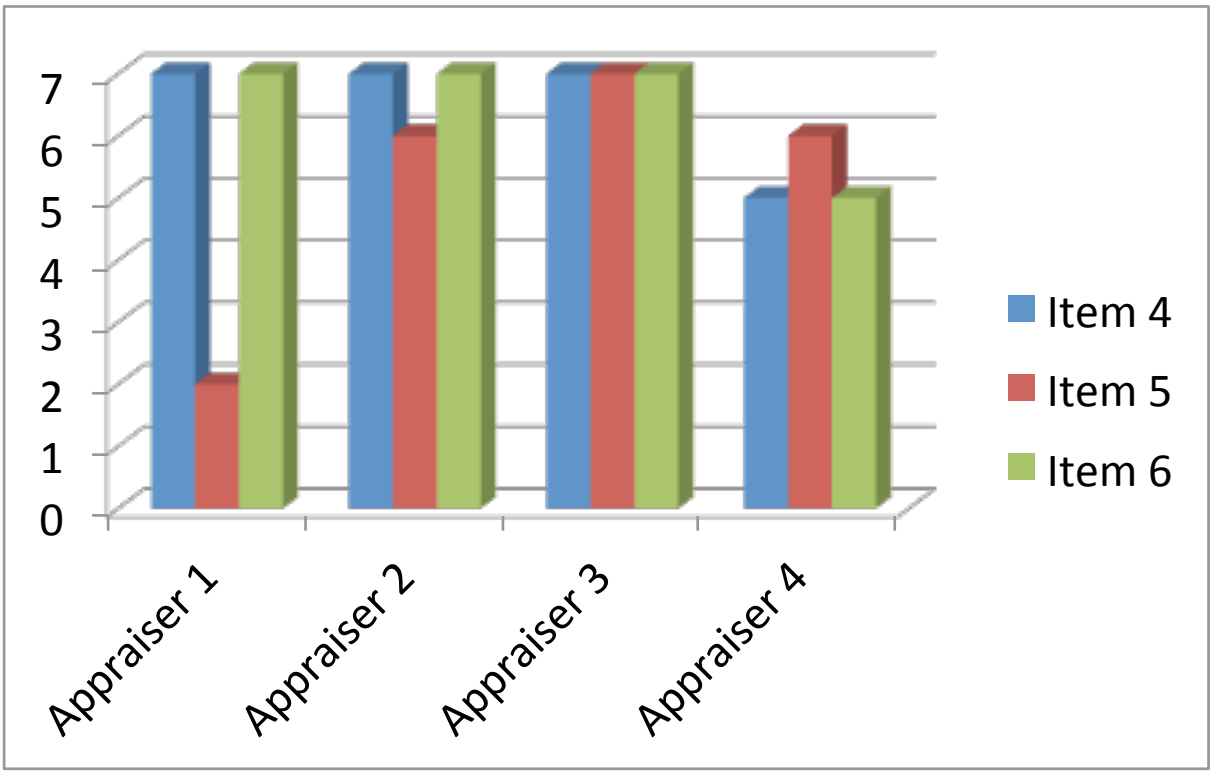


BTS/SIGN Guideline

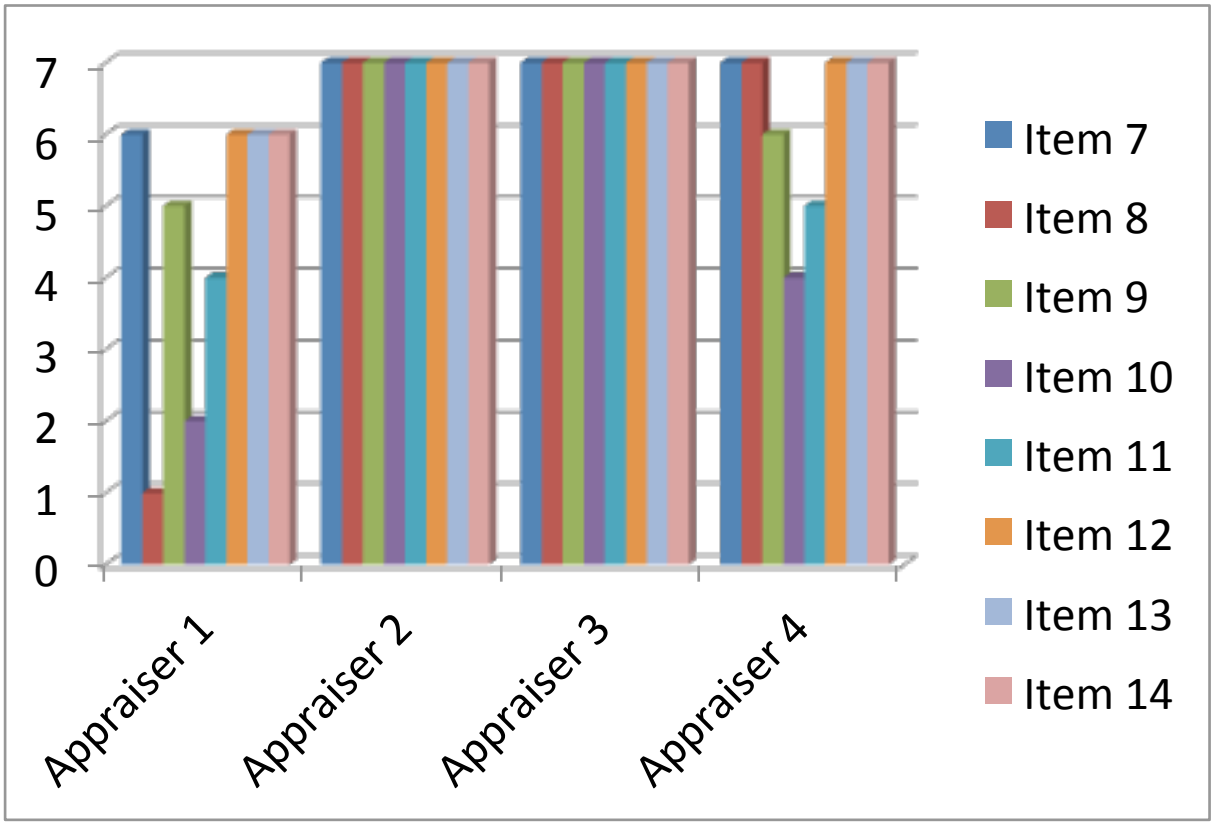
BTS/SIGN – Domain 1: Scope and Purpose



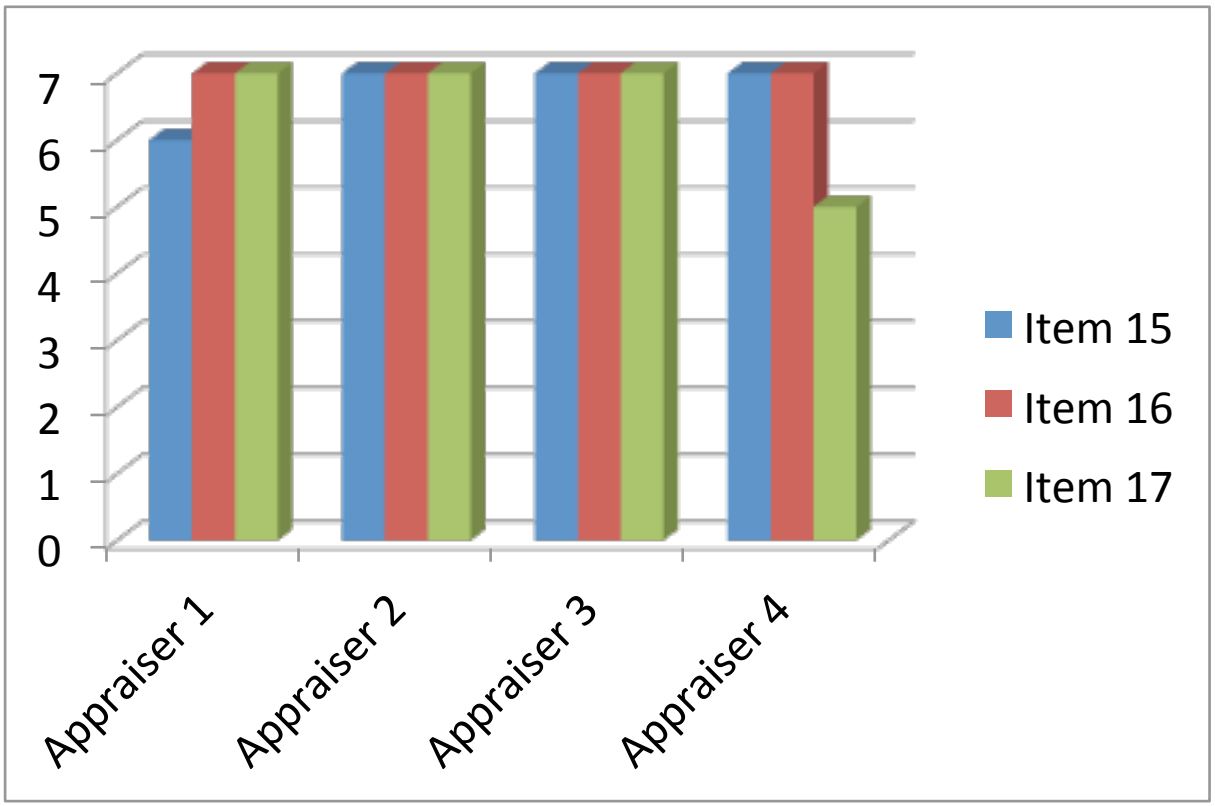
BTS/SIGN – Domain 2: Stakeholder Involvement



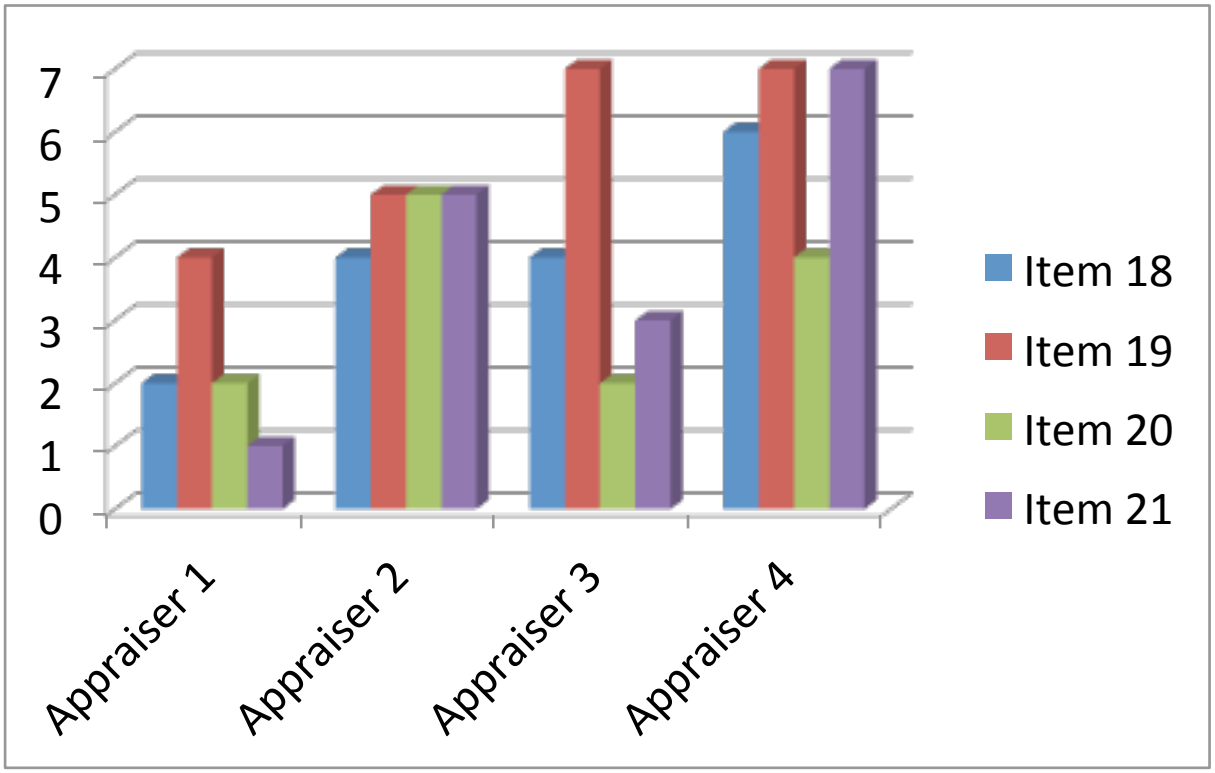
BTS/SIGN – Domain 3: Rigour of Development



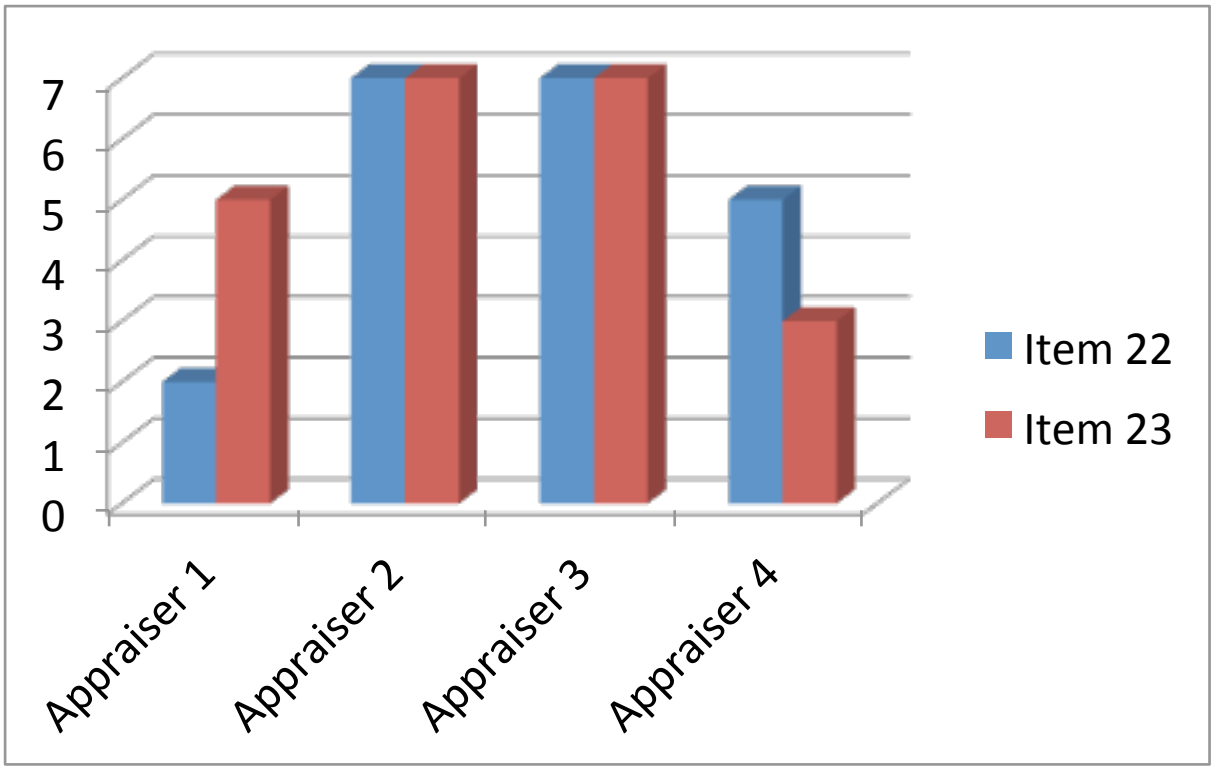
BTS/SIGN – Domain 4: Clarity of presentation



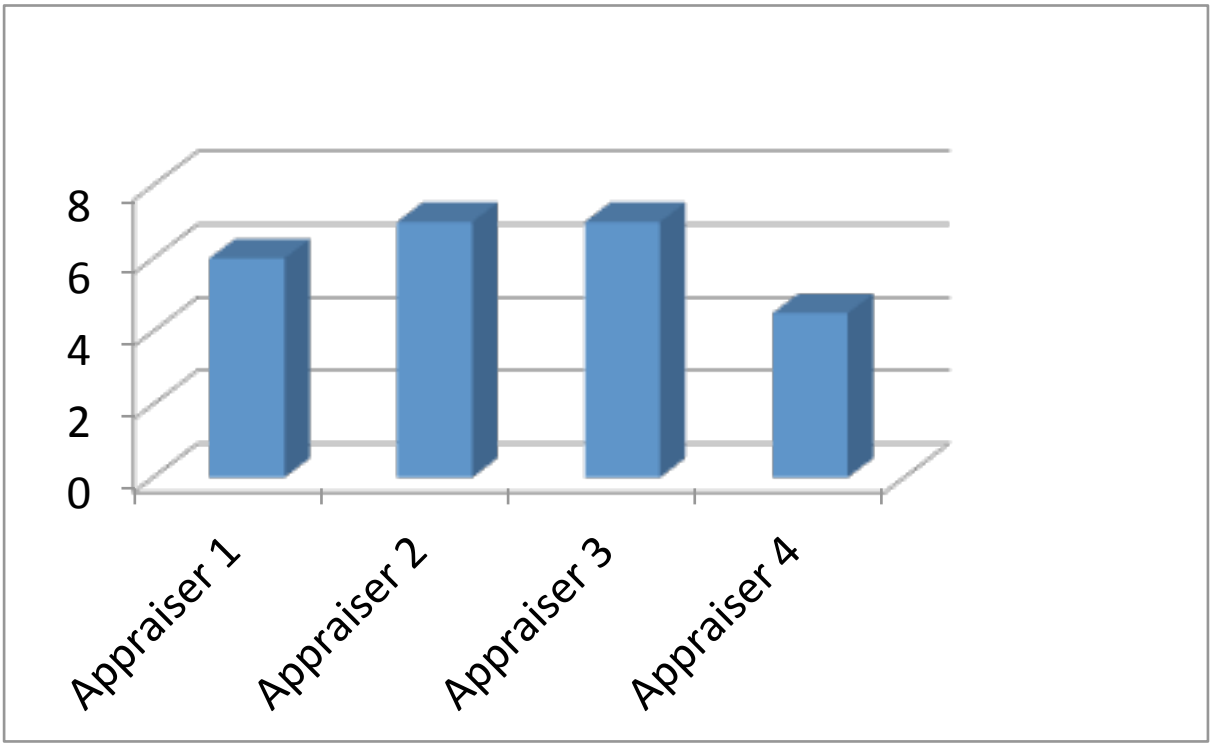
BTS/SIGN – Domain 5: Applicability



BTS/SIGN – Domain 6: Editorial Independence

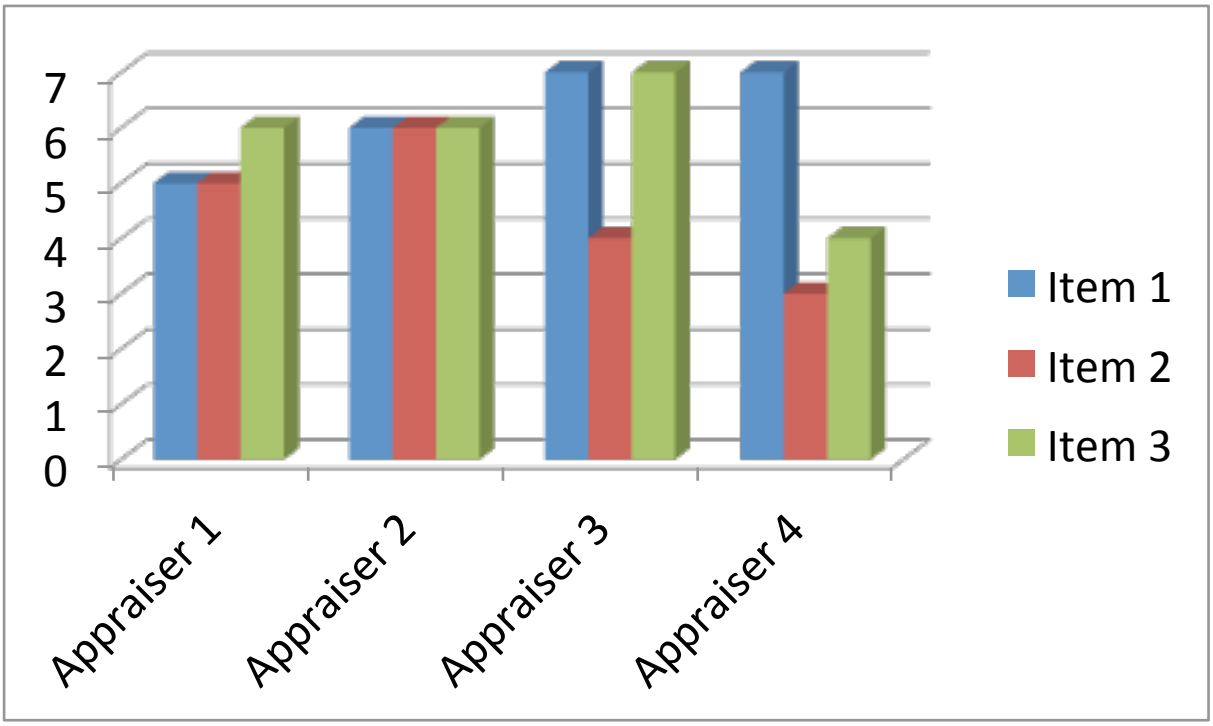


BTS/SIGN - Overall Assessment

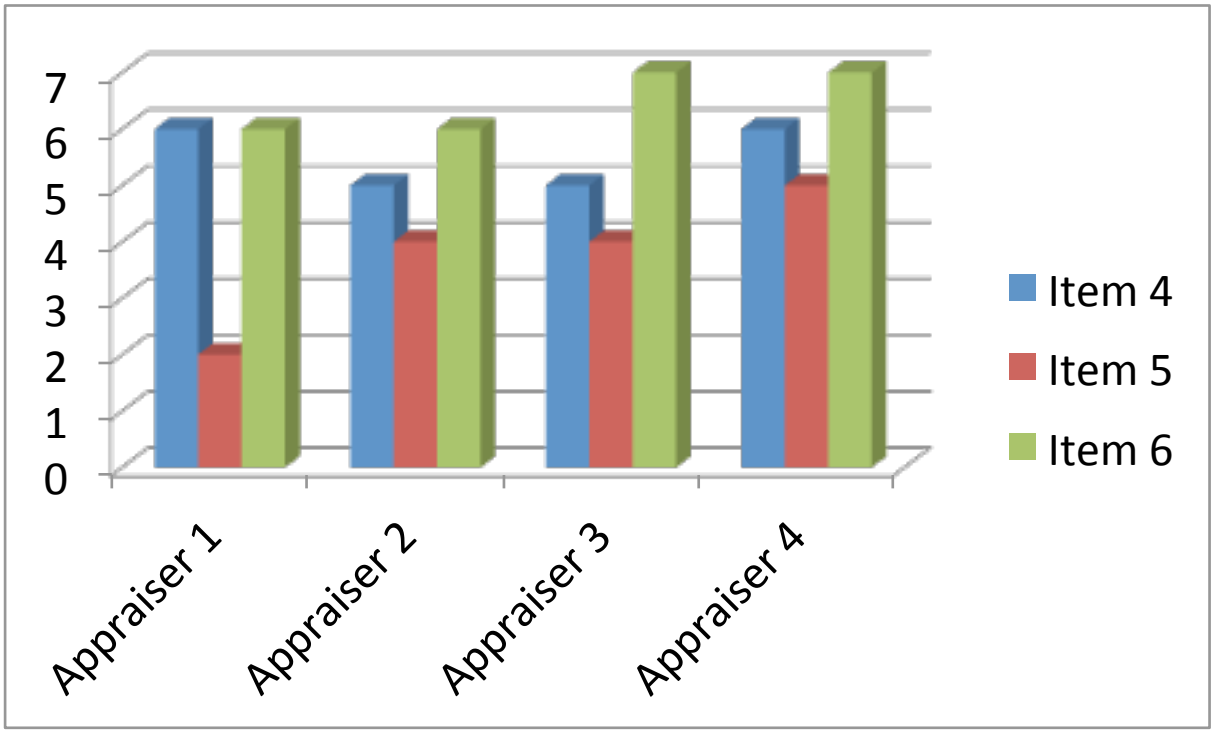


GINA Guideline

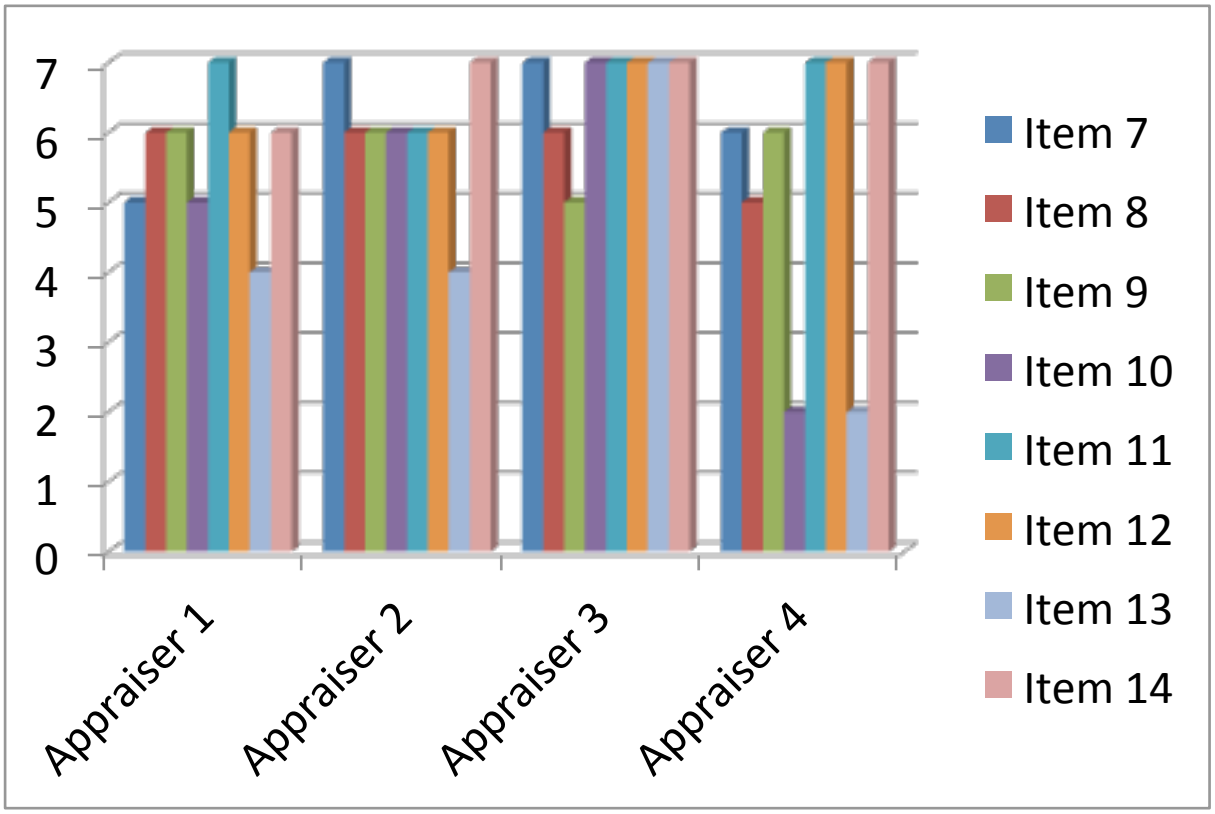
GINA – Domain 1: Scope and Purpose



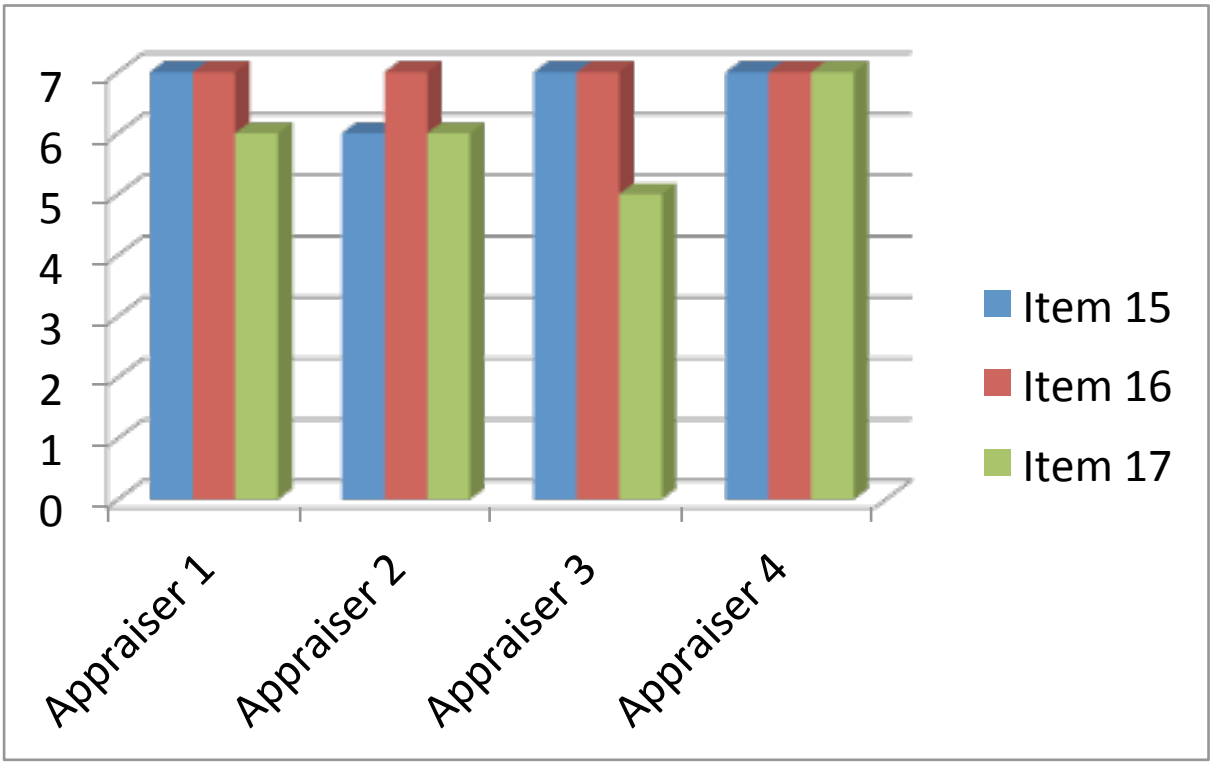
GINA – Domain 2: Stakeholder Involvement



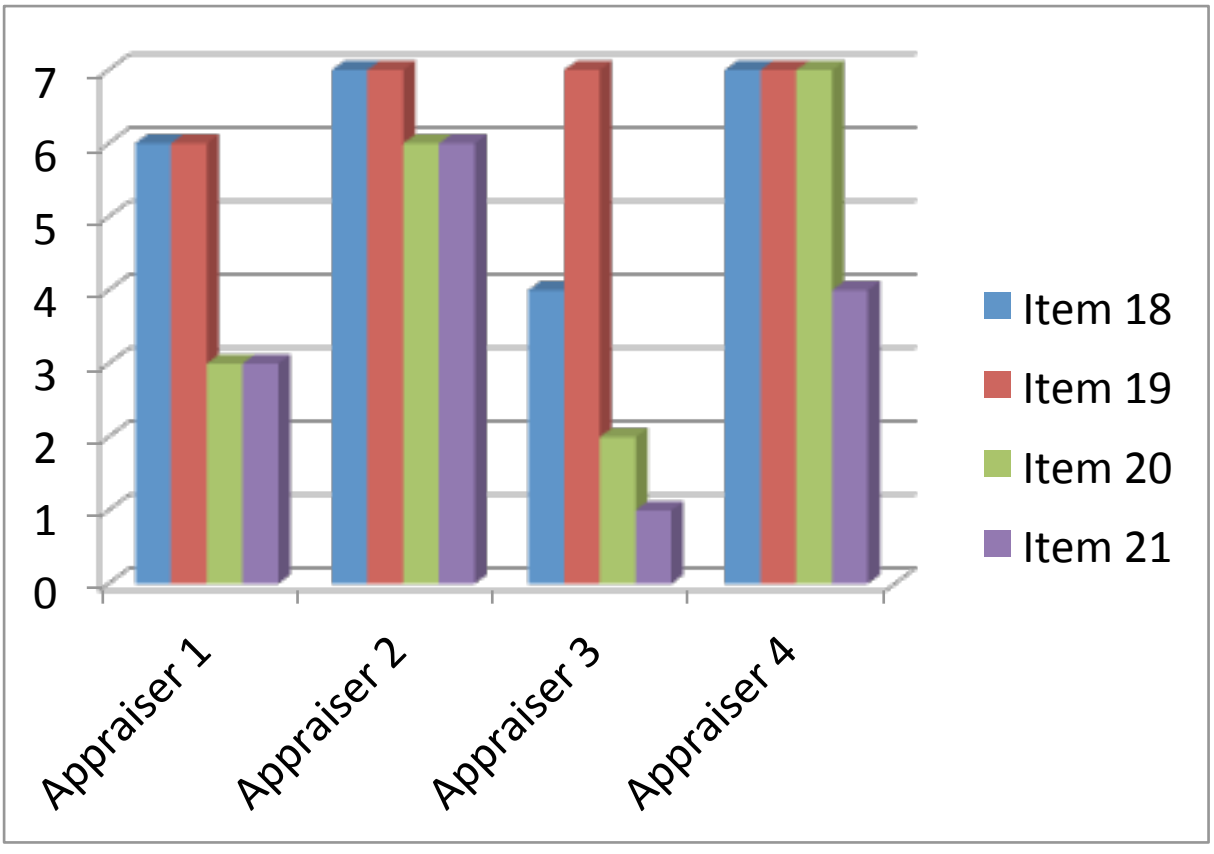
GINA – Domain 3: Rigour of Development



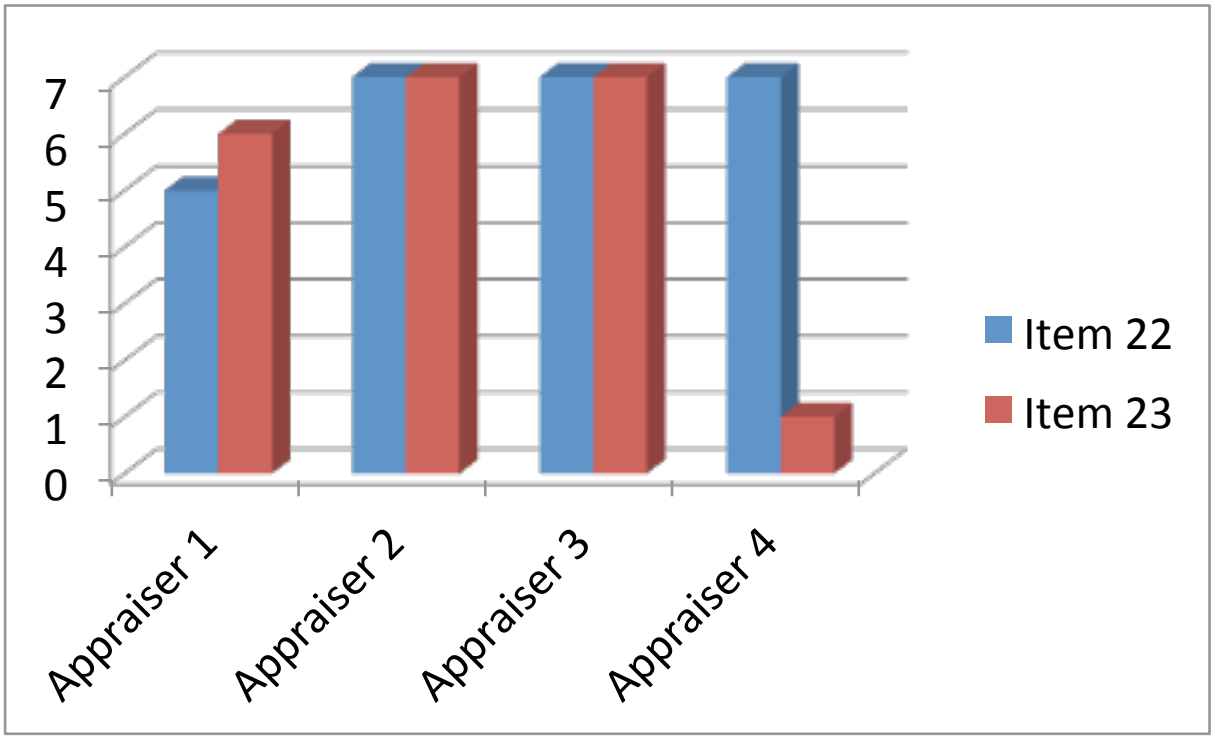
GINA – Domain 4: Clarity of Presentation



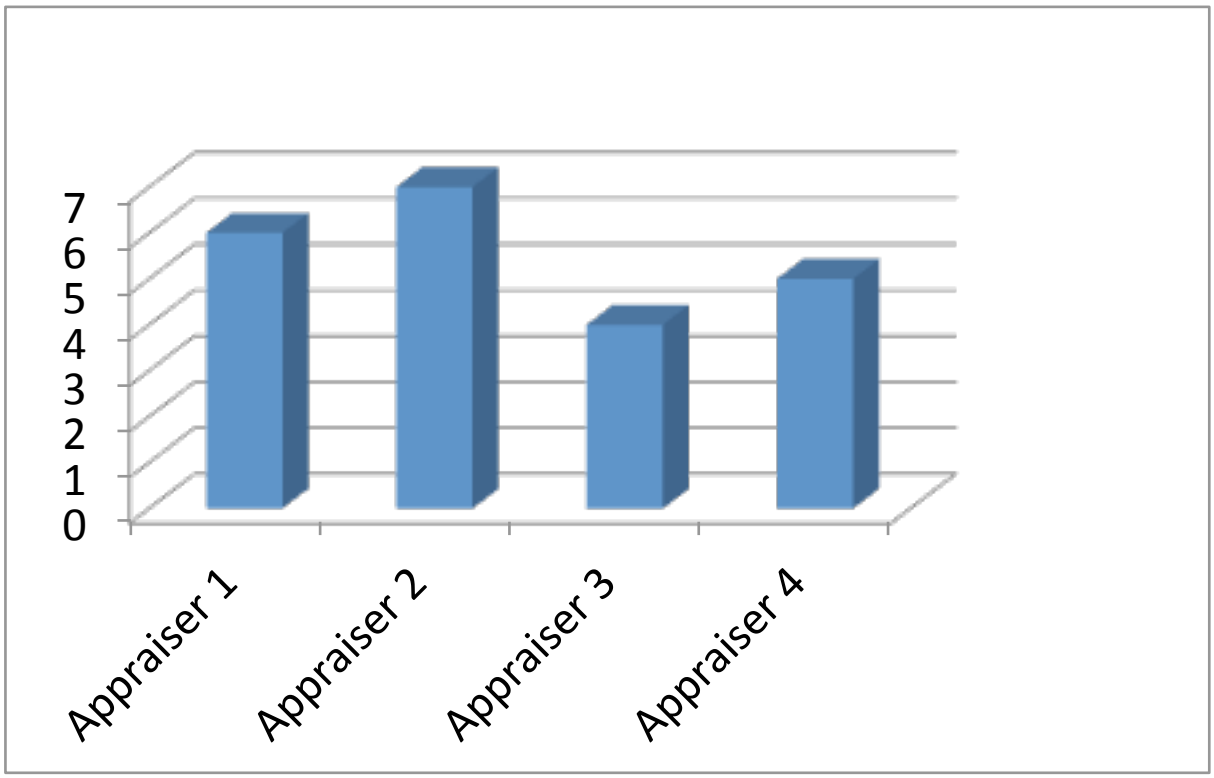
GINA – Domain 5: Applicability



GINA – Domain 6: Editorial Independence



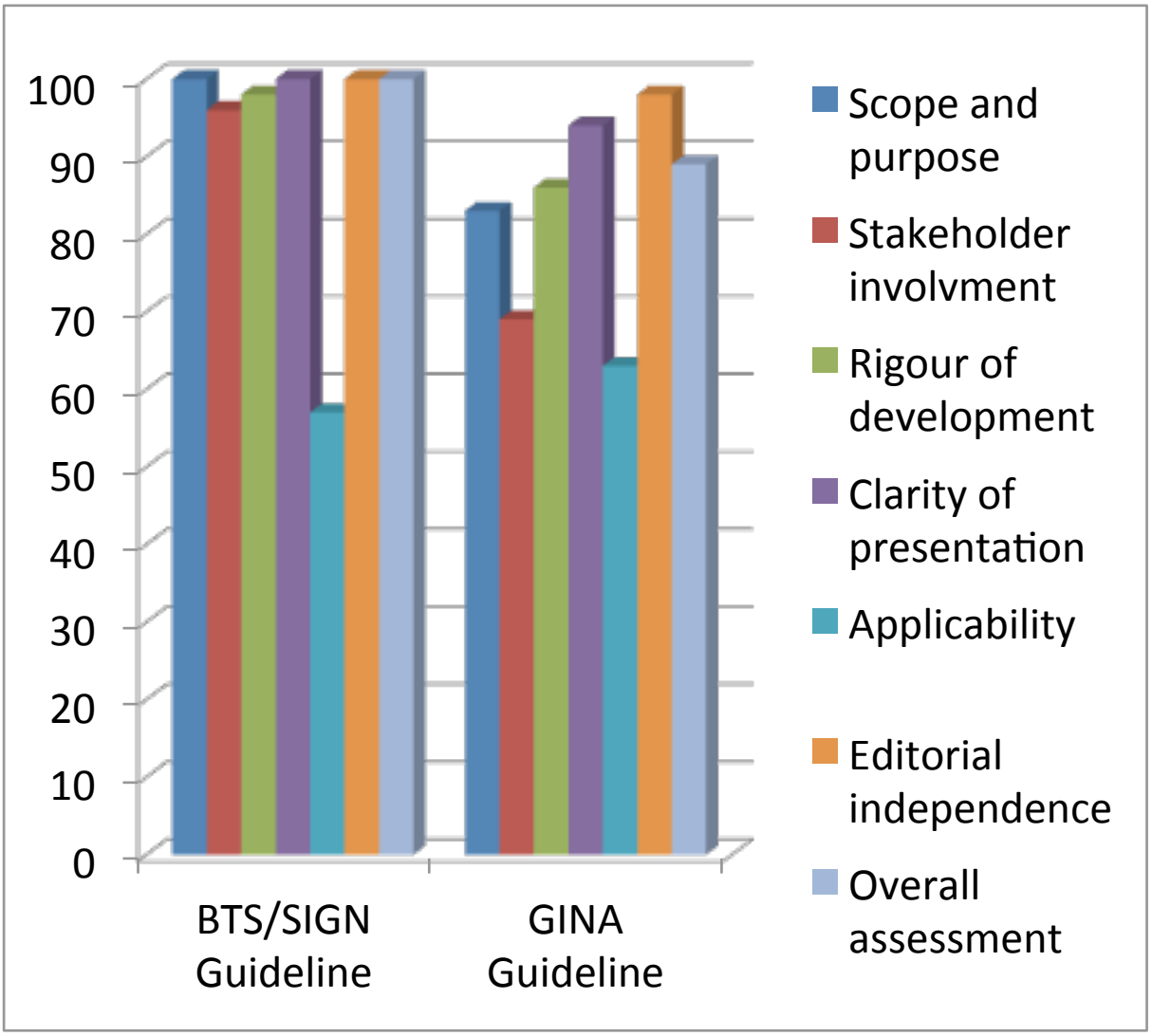
GINA - Overall Assessment



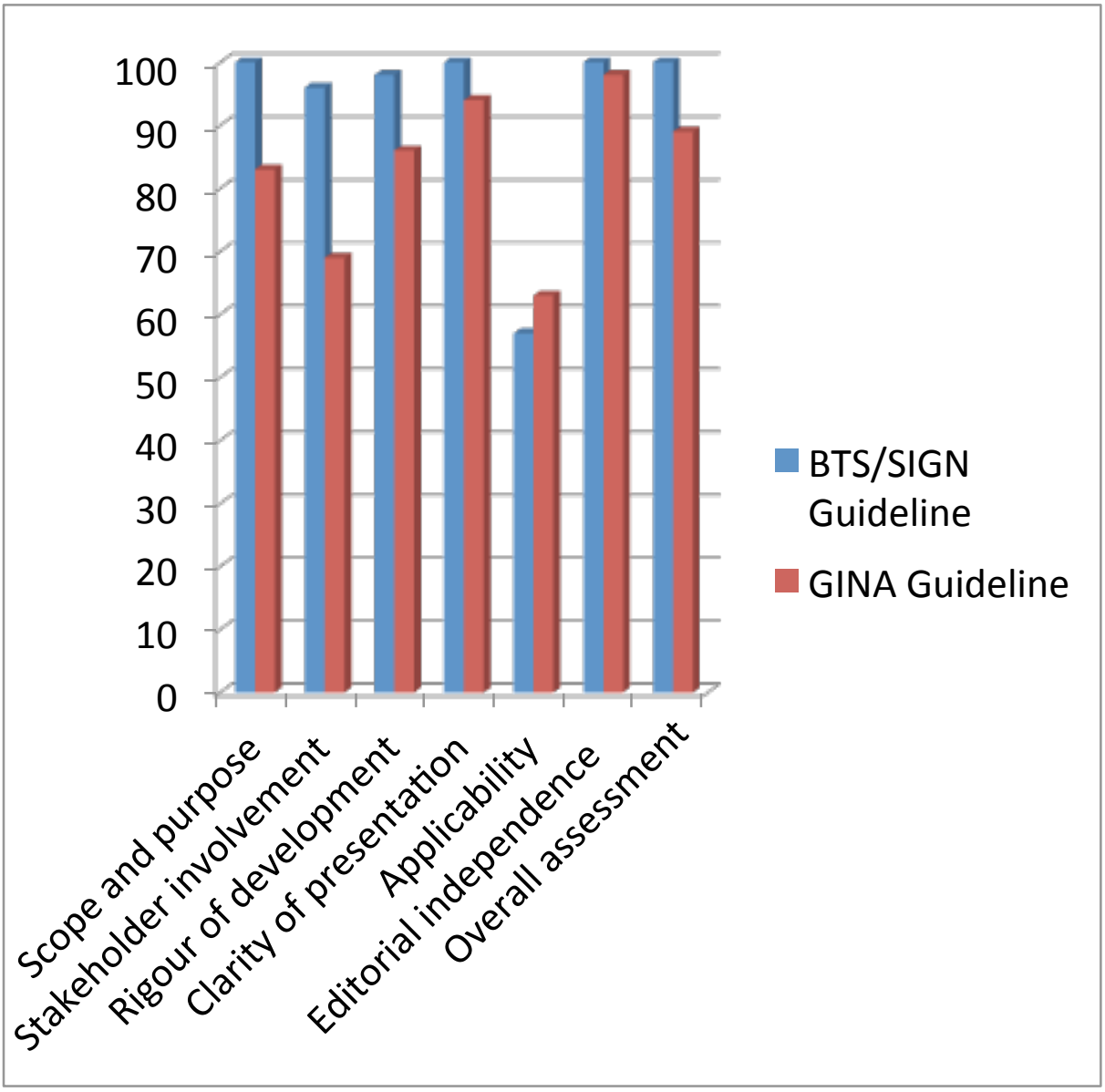
Appendix 9: Revisions to quality appraisal visual graphs

(overall scores and inter-rater agreement)

Domains – overview – both guidelines

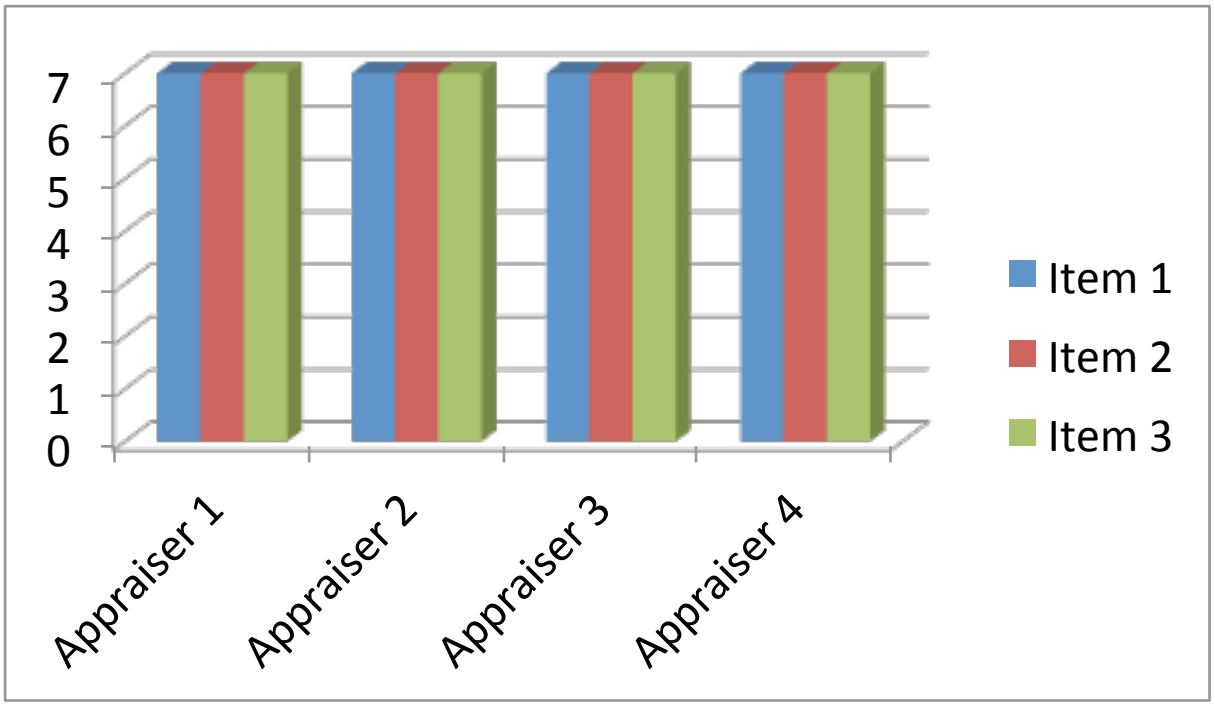


Domains – overview – both guidelines

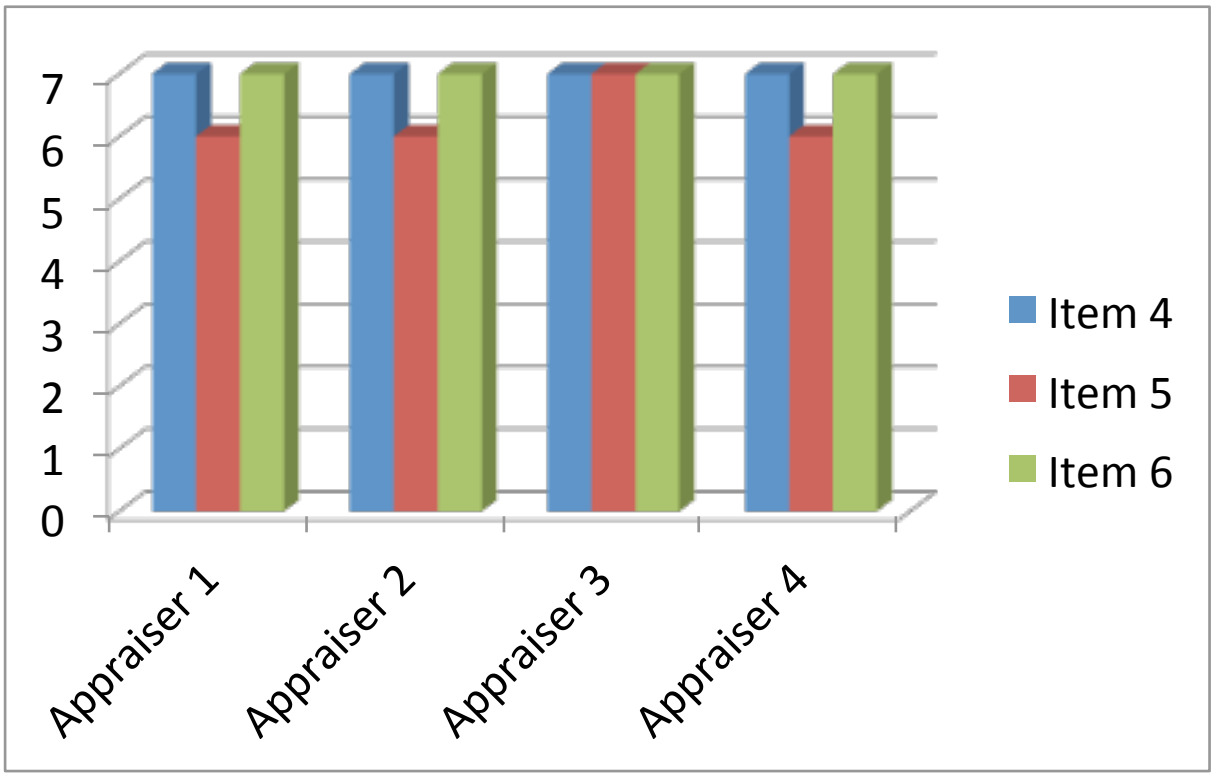


BTS/SIGN Guideline

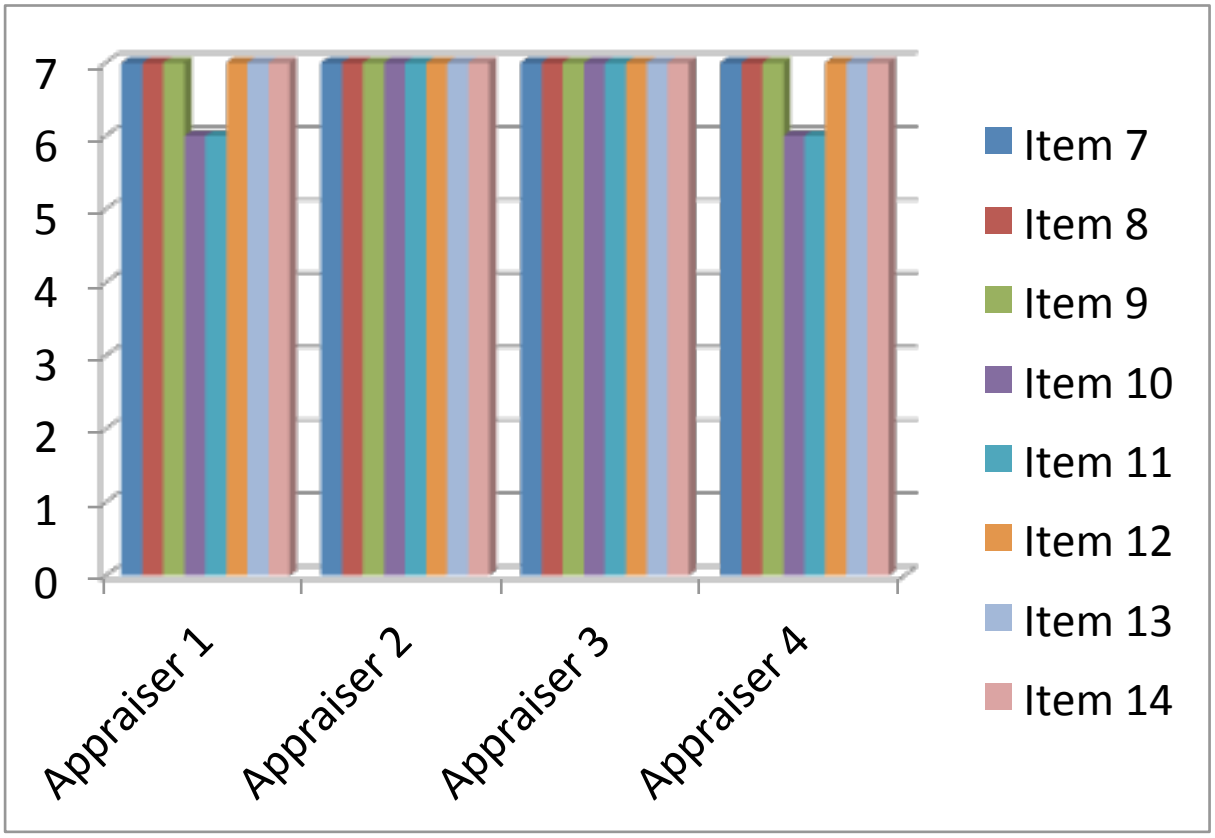
BTS/SIGN – Domain 1: Scope and Purpose



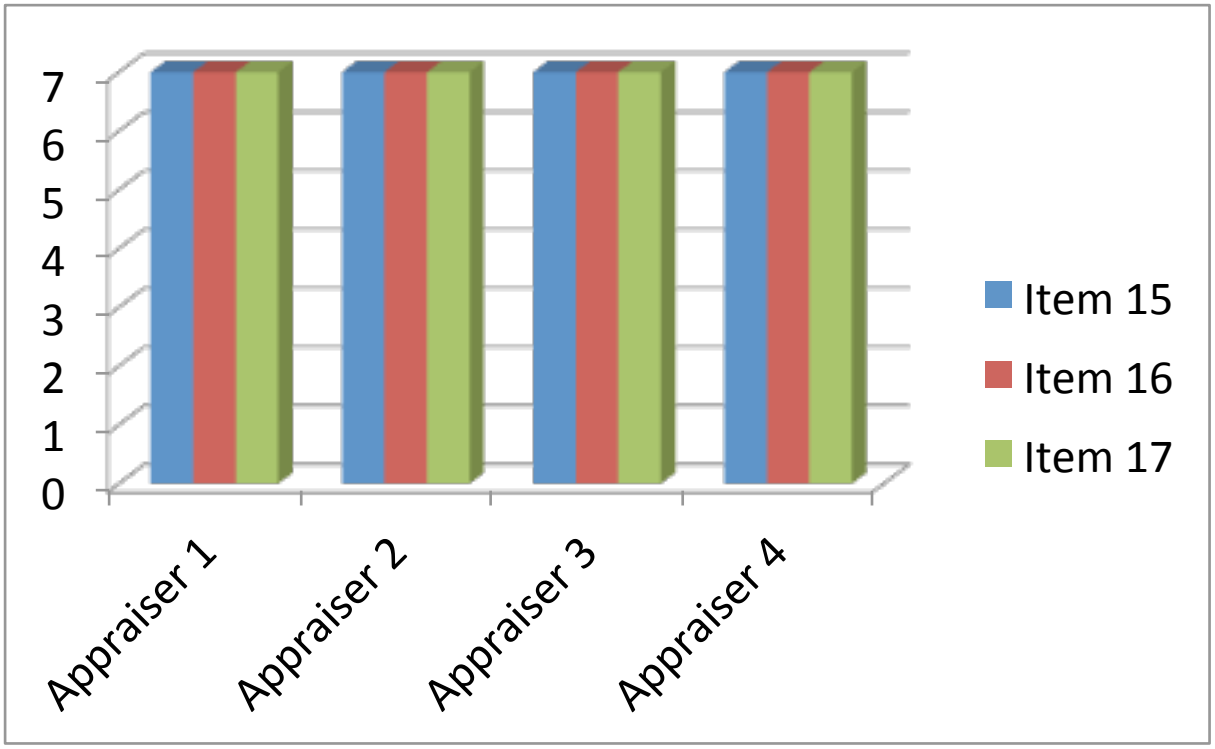
BTS/SIGN – Domain 2: Stakeholder Involvement



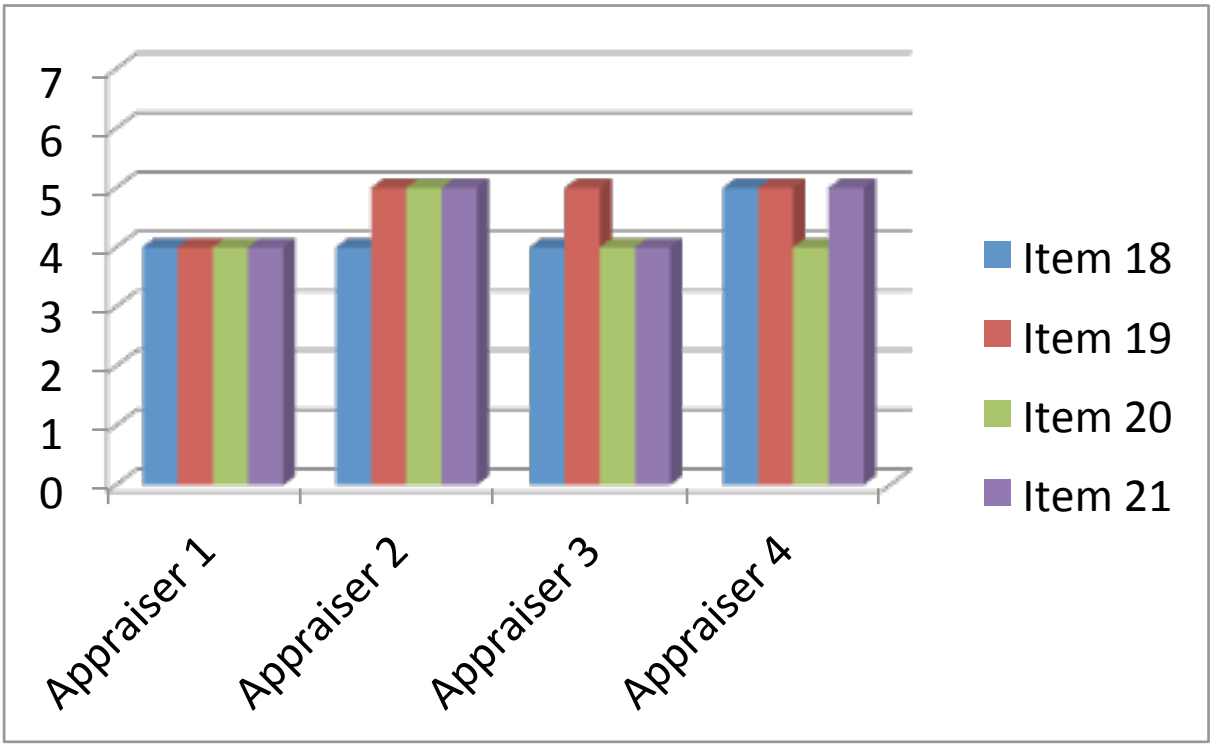
BTS/SIGN – Domain 3: Rigour of Development



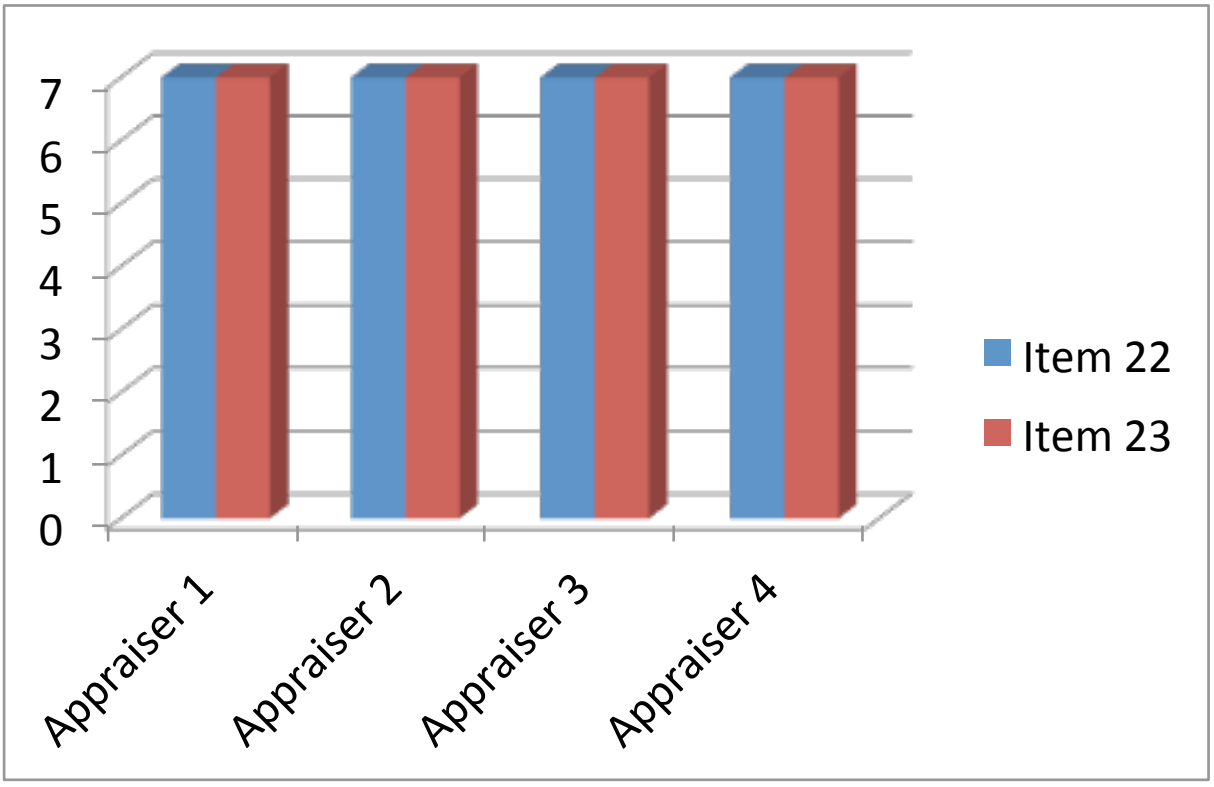
BTS/SIGN – Domain 4: Clarity of presentation



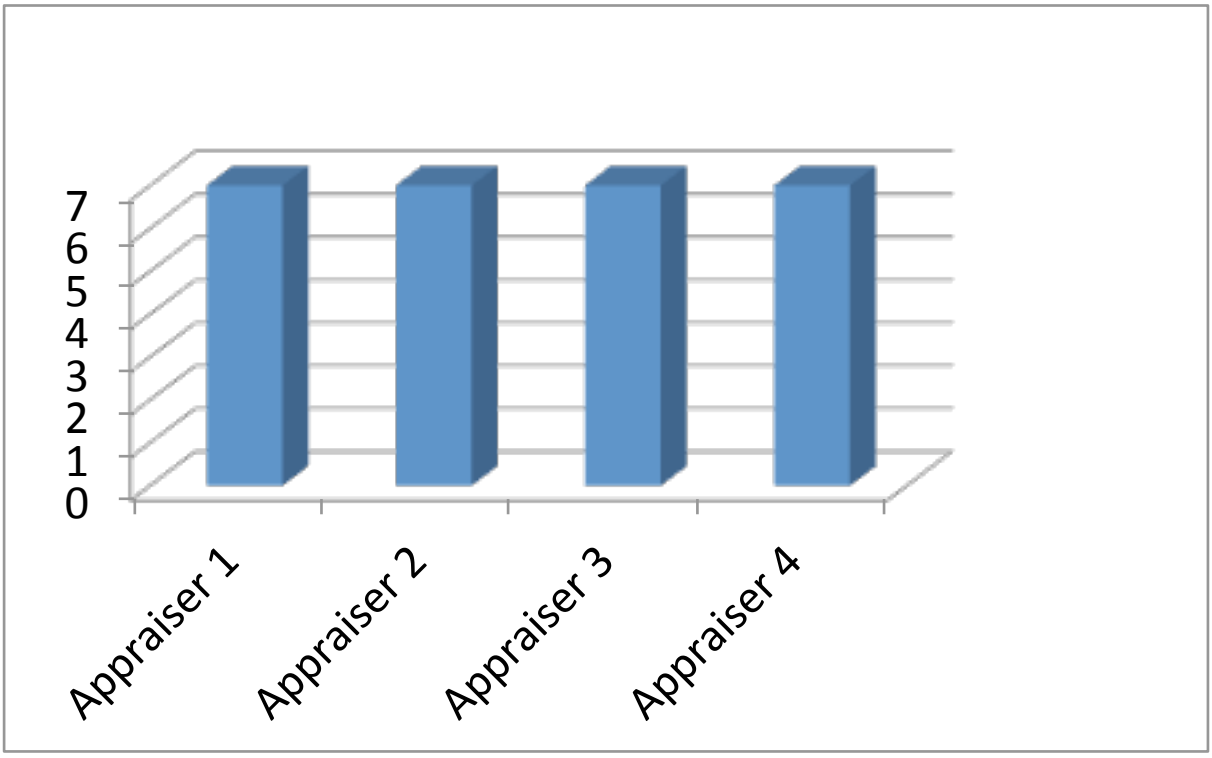
BTS/SIGN – Domain 5: Applicability



BTS/SIGN – Domain 6: Editorial Independence

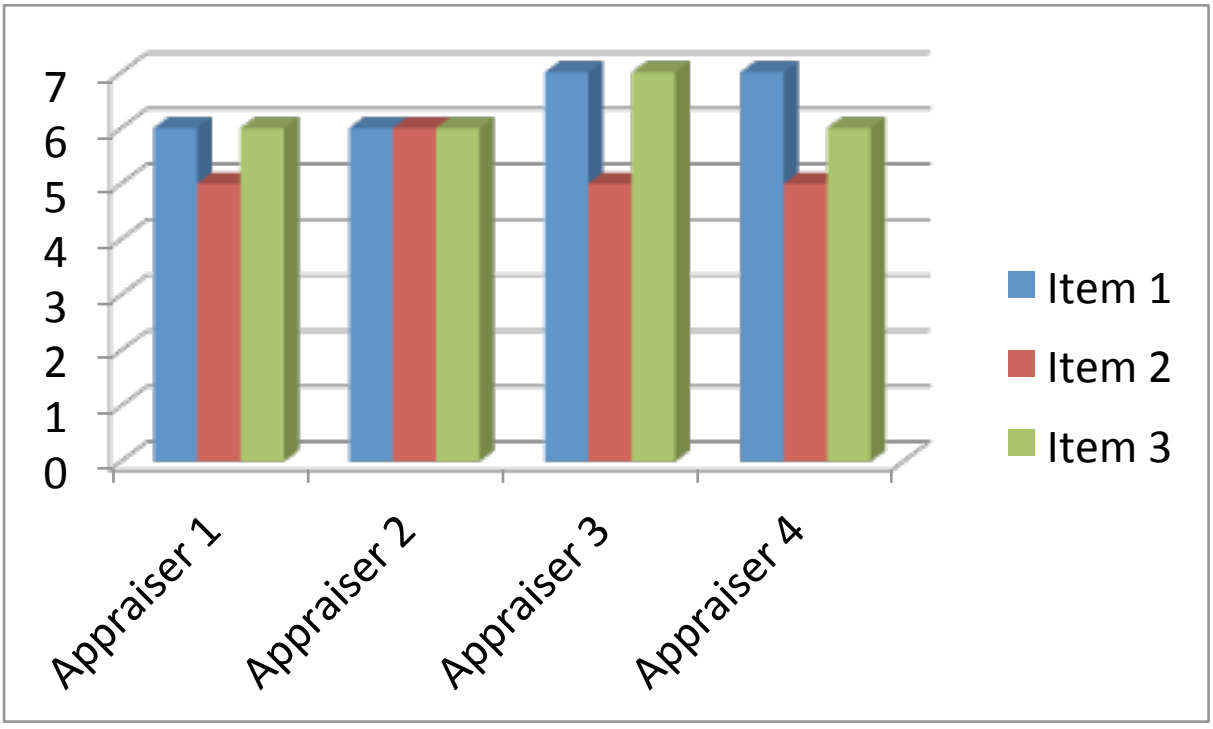


BTS/SIGN - Overall Assessment

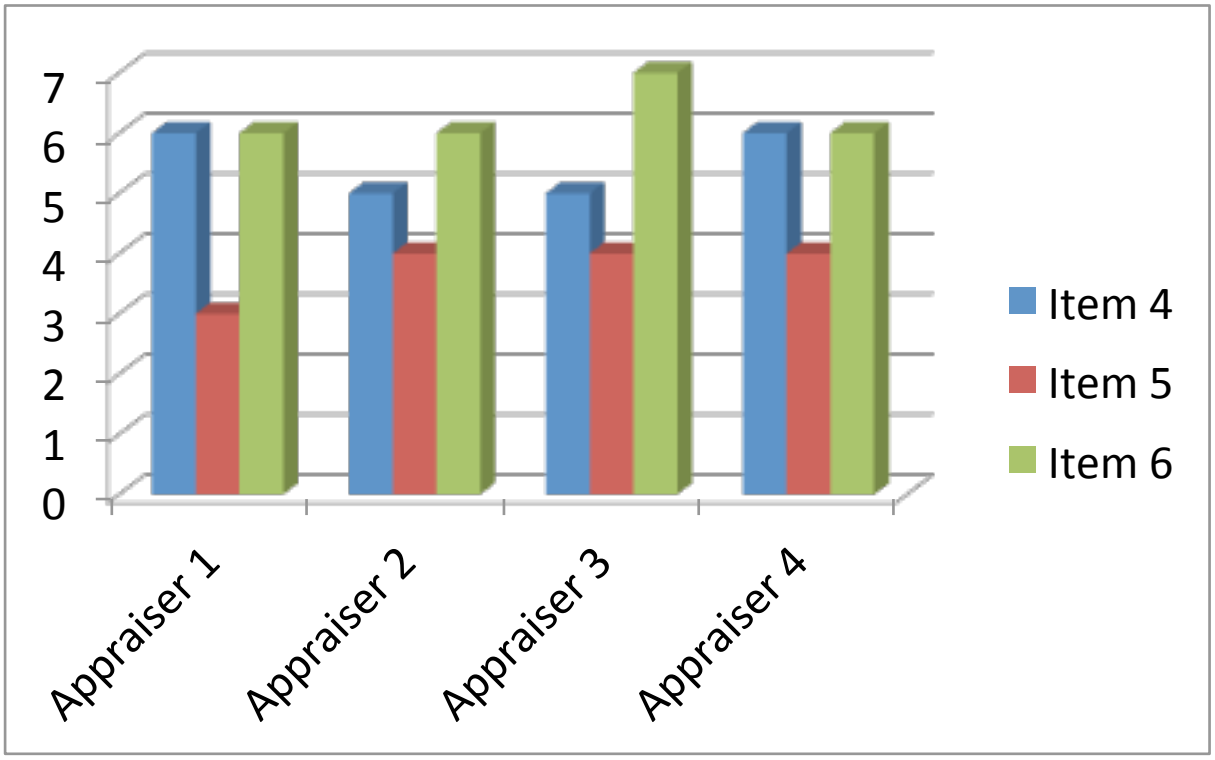


GINA Guideline

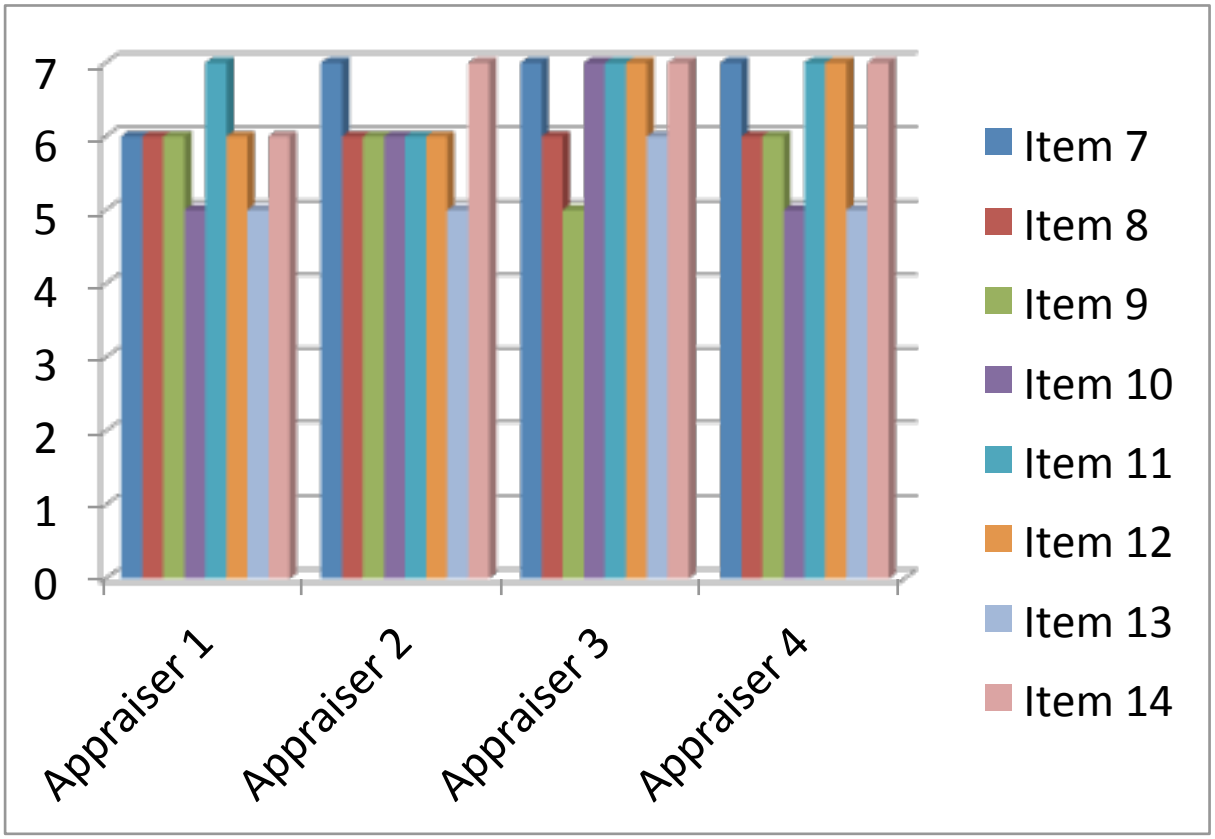
GINA – Domain 1: Scope and Purpose



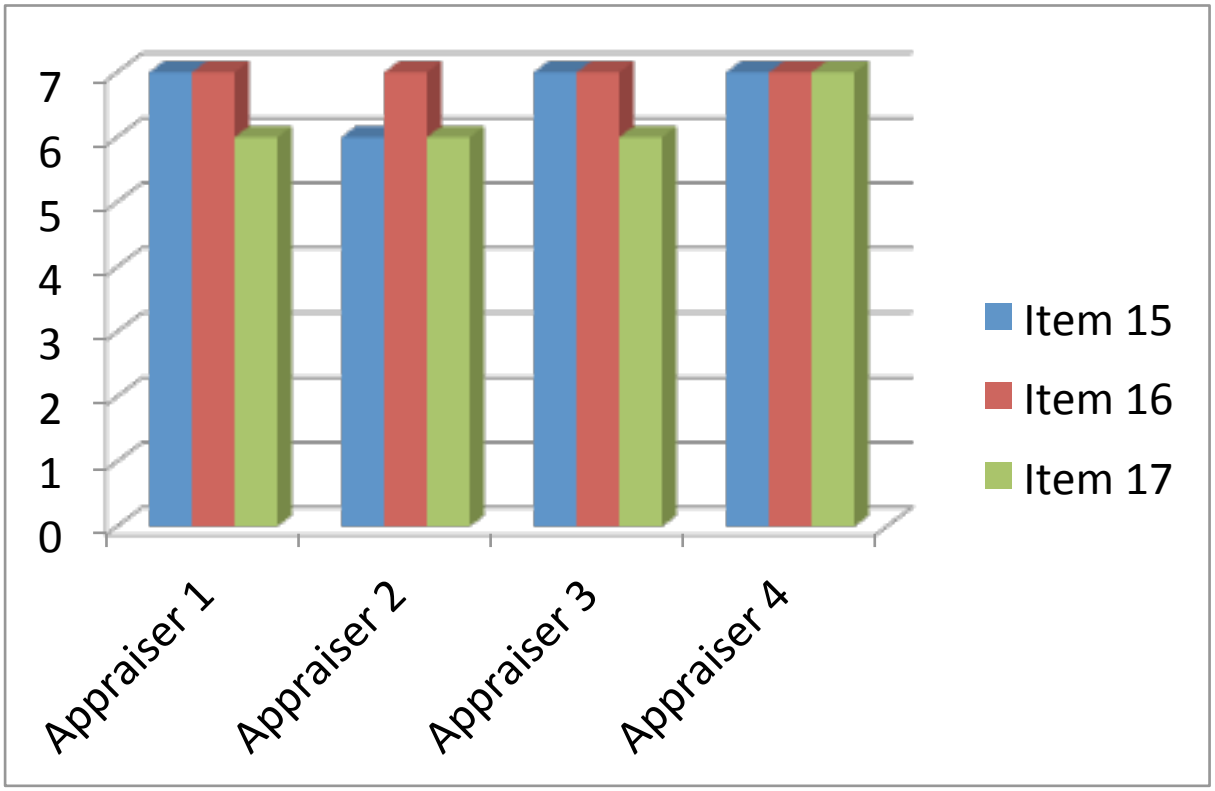
GINA – Domain 2: Stakeholder Involvement



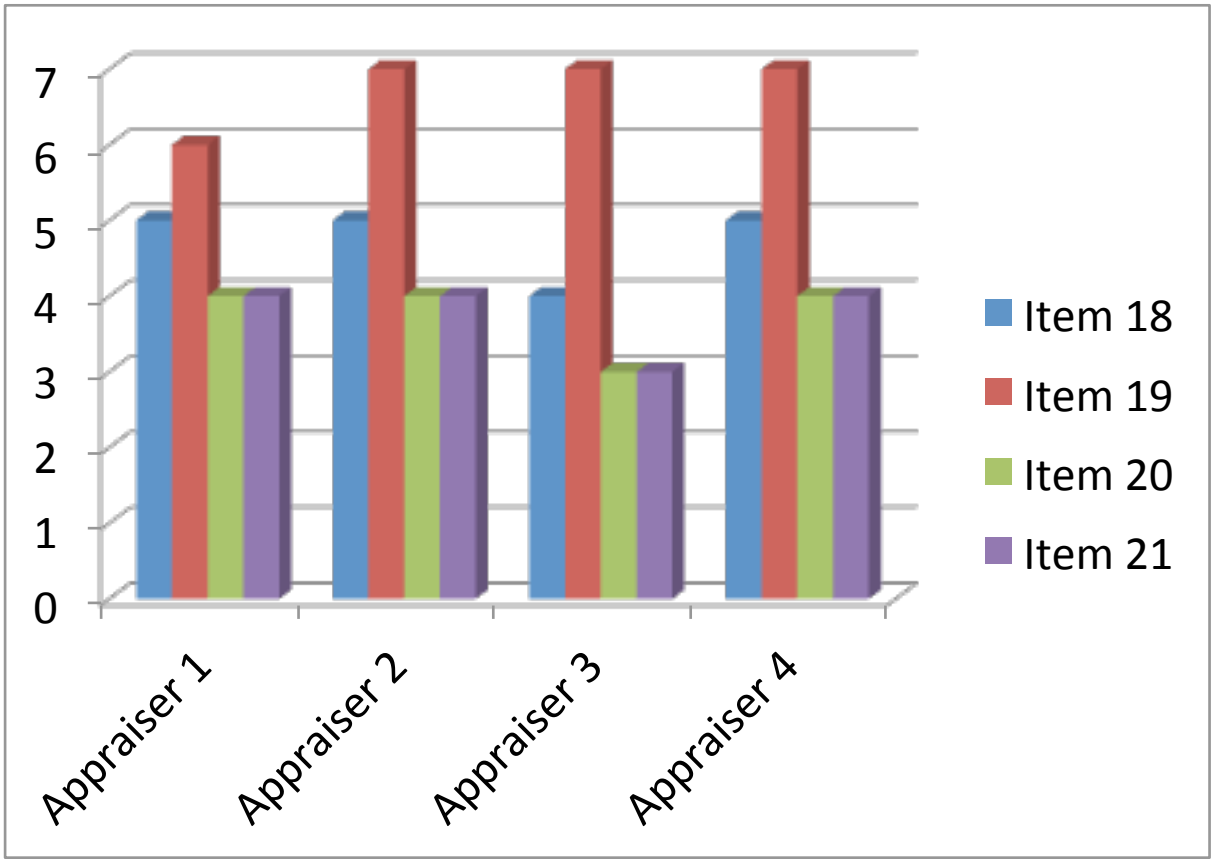
GINA – Domain 3: Rigour of Development



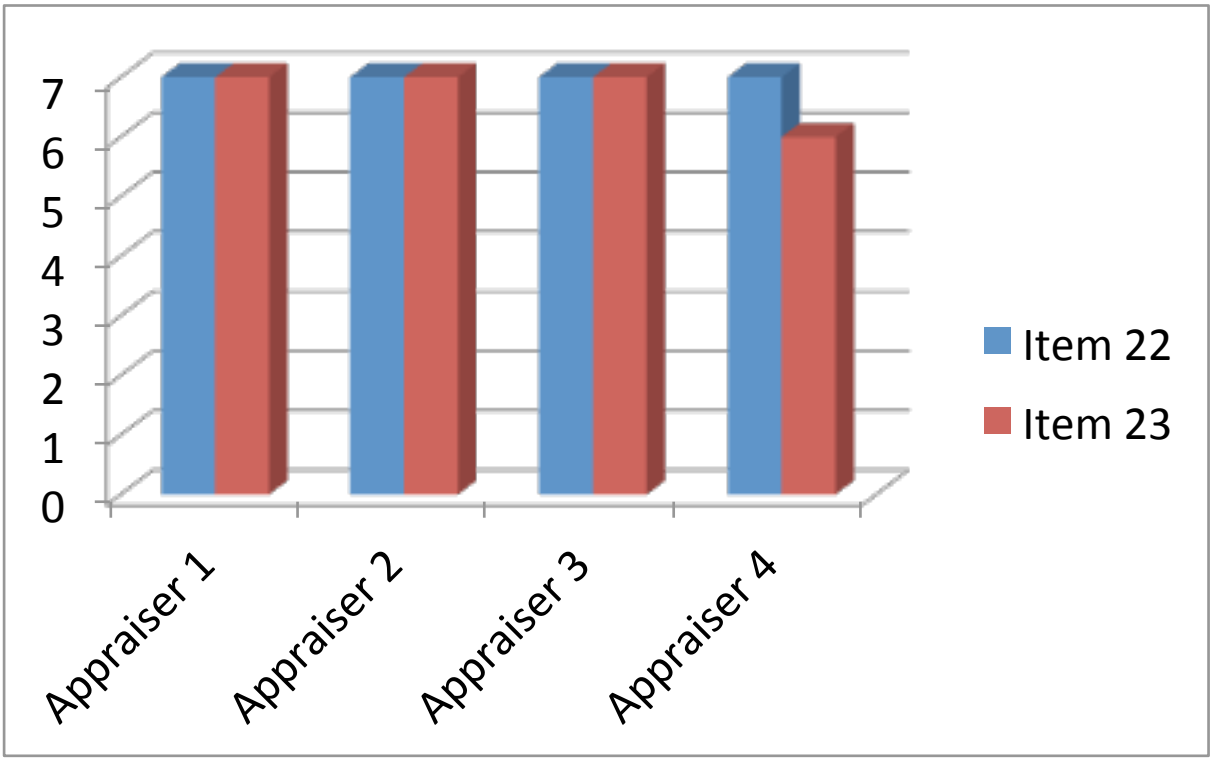
GINA – Domain 4: Clarity of Presentation



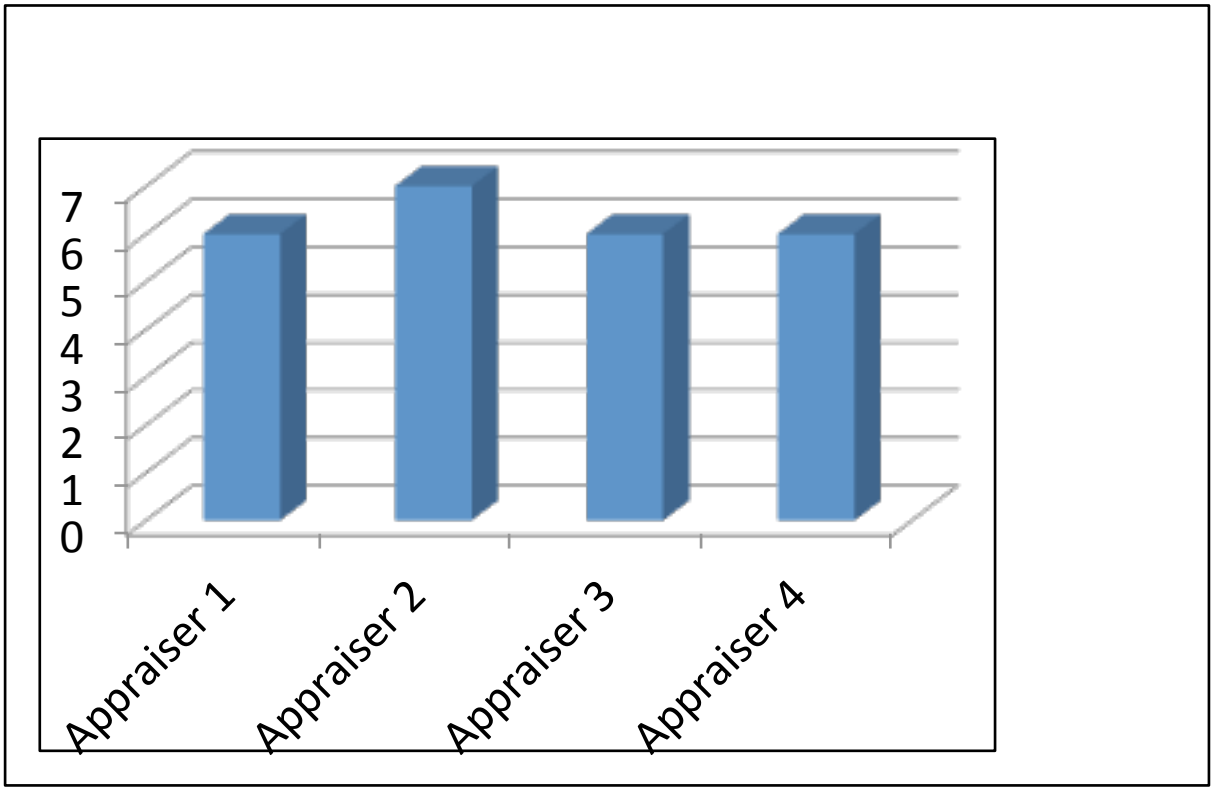
GINA – Domain 5: Applicability



GINA – Domain 6: Editorial Independence

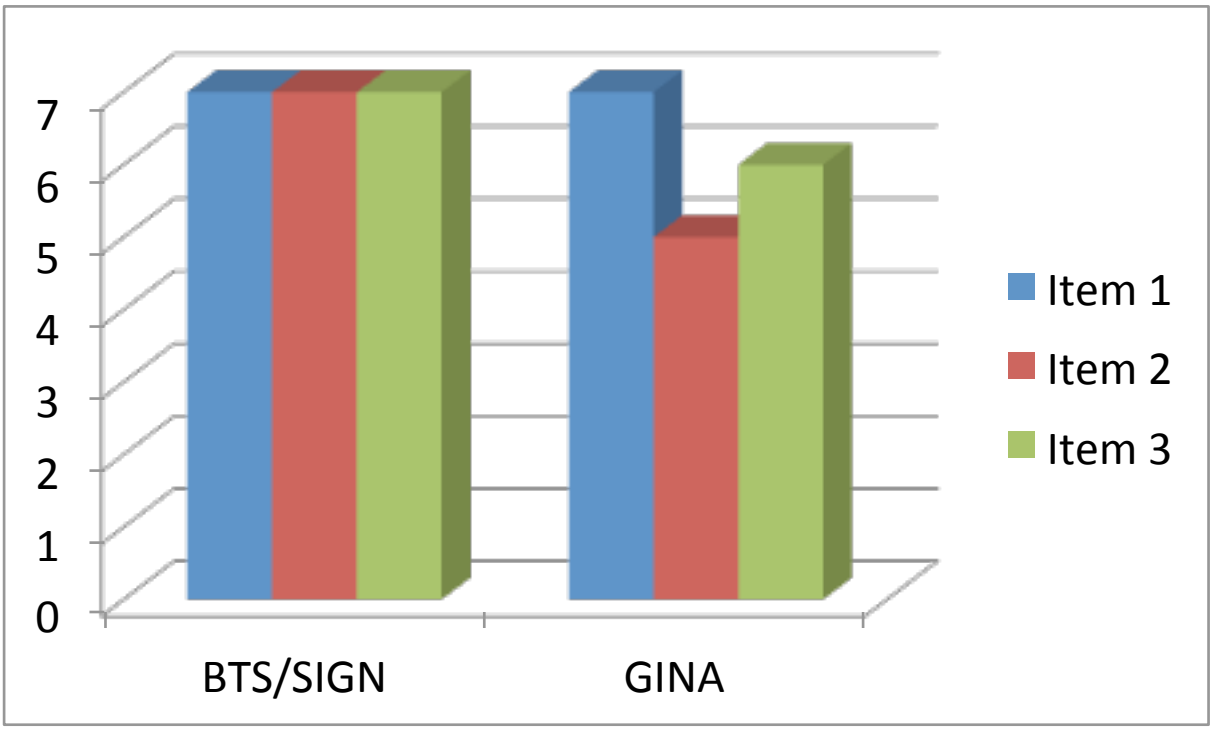


GINA - Overall Assessment

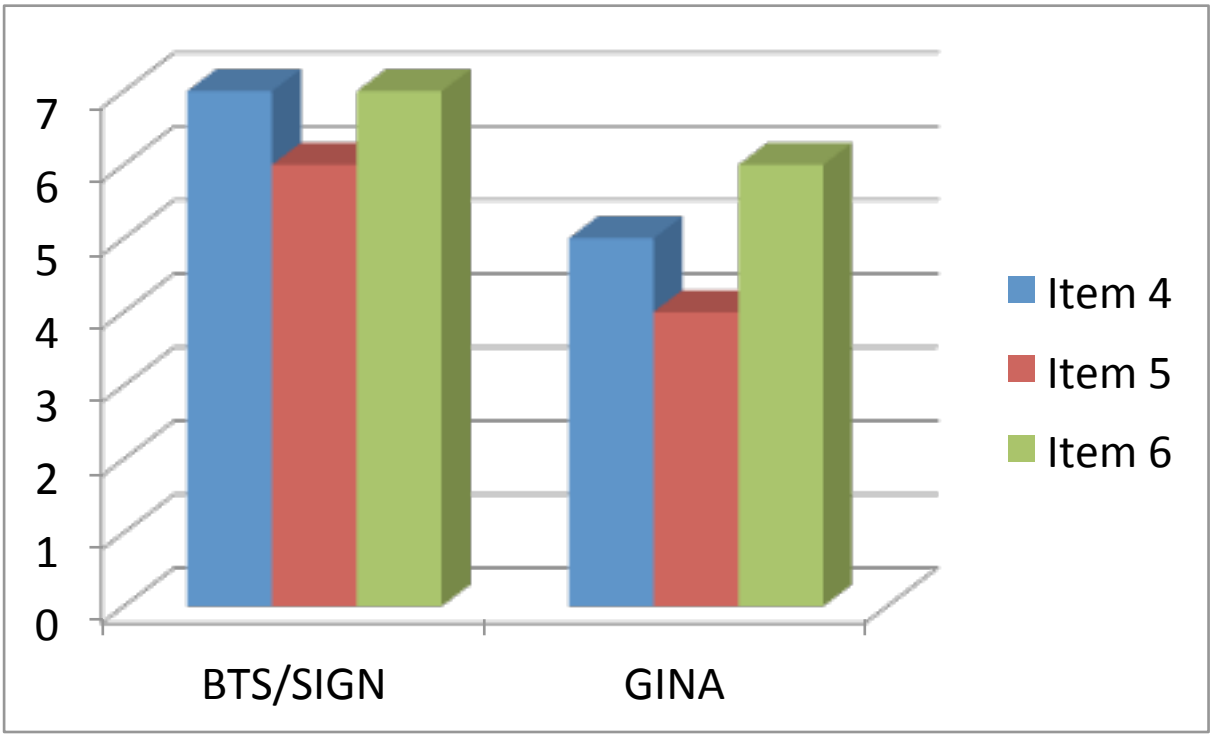


Appendix 10: Group consensus appraisal scores

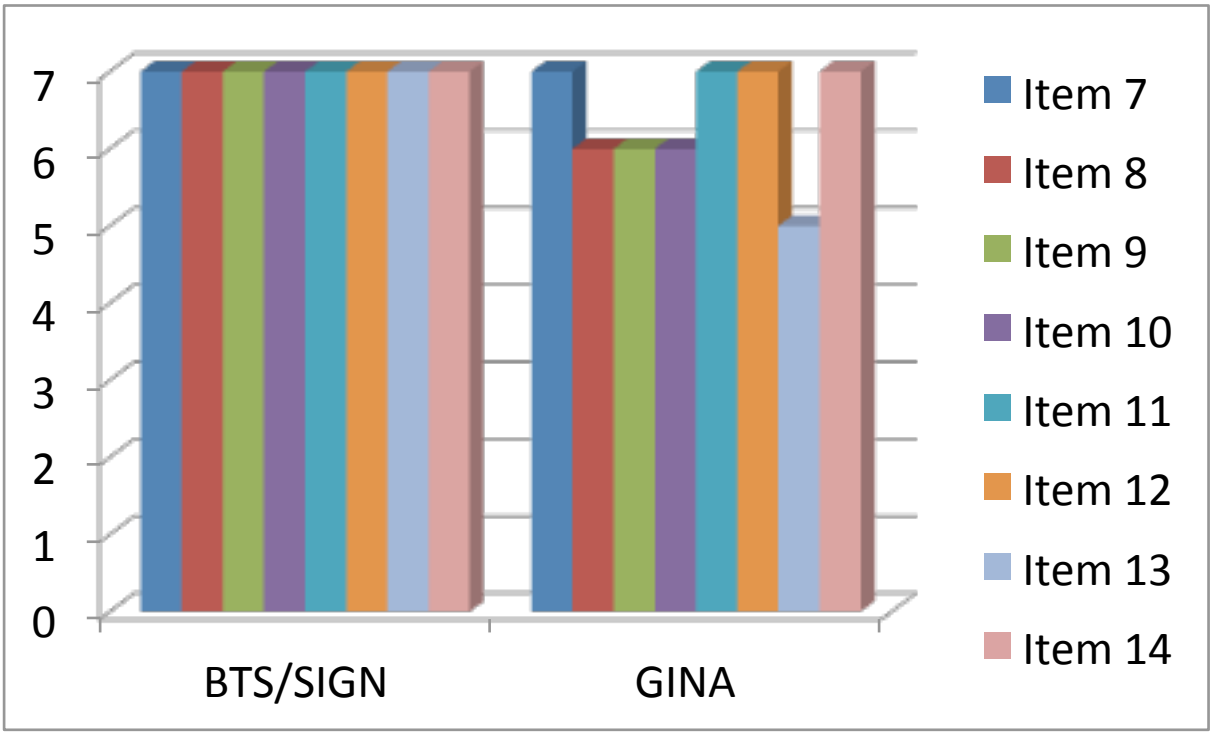
Domain 1: Scope and Purpose (both BTS/SIGN and GINA)



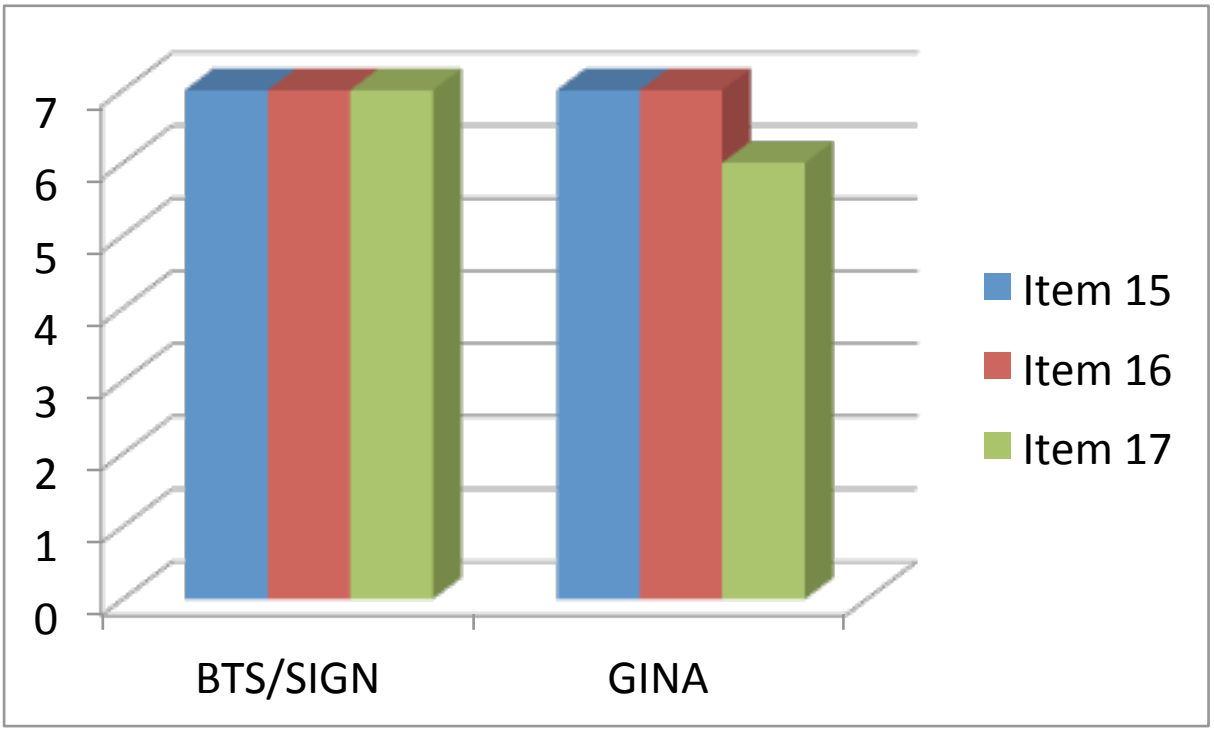
Domain 2: Stakeholder Involvement (both BTS/SIGN and GINA)



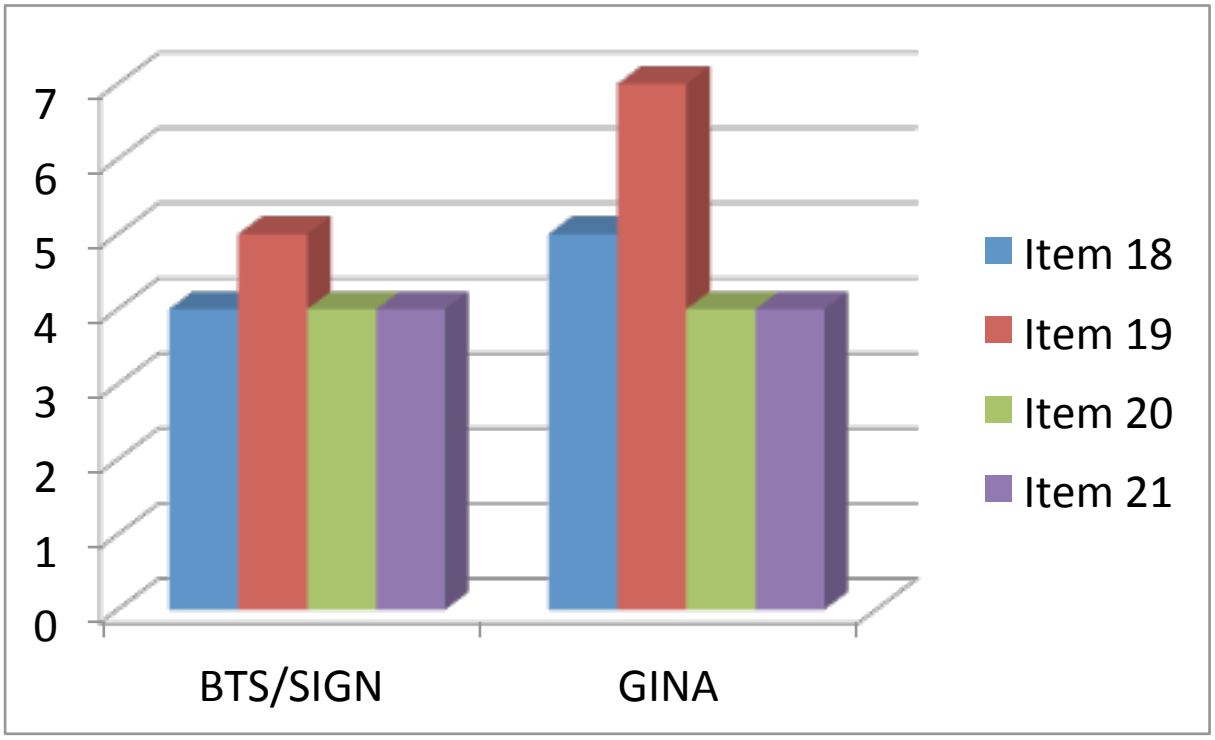
Domain 3: Rigour of Development (both BTS/SIGN and GINA)



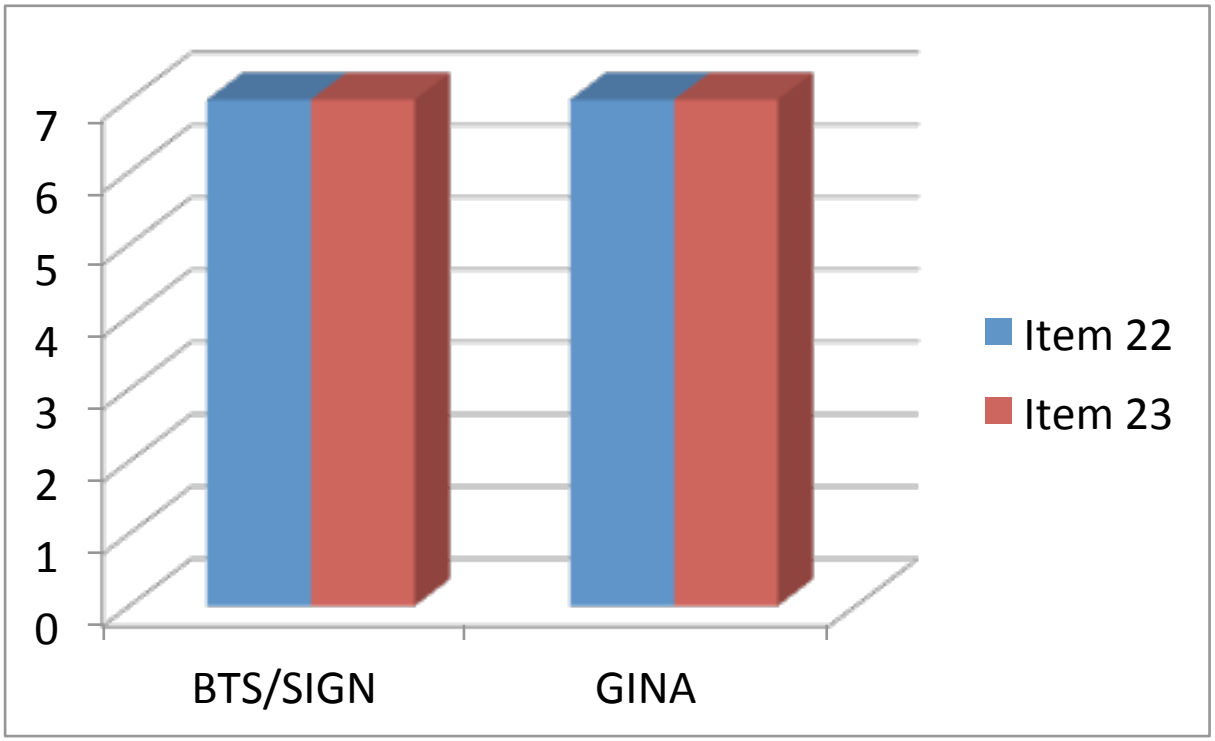
Domain 4: Clarity of Presentation (both BTS/SIGN and GINA)



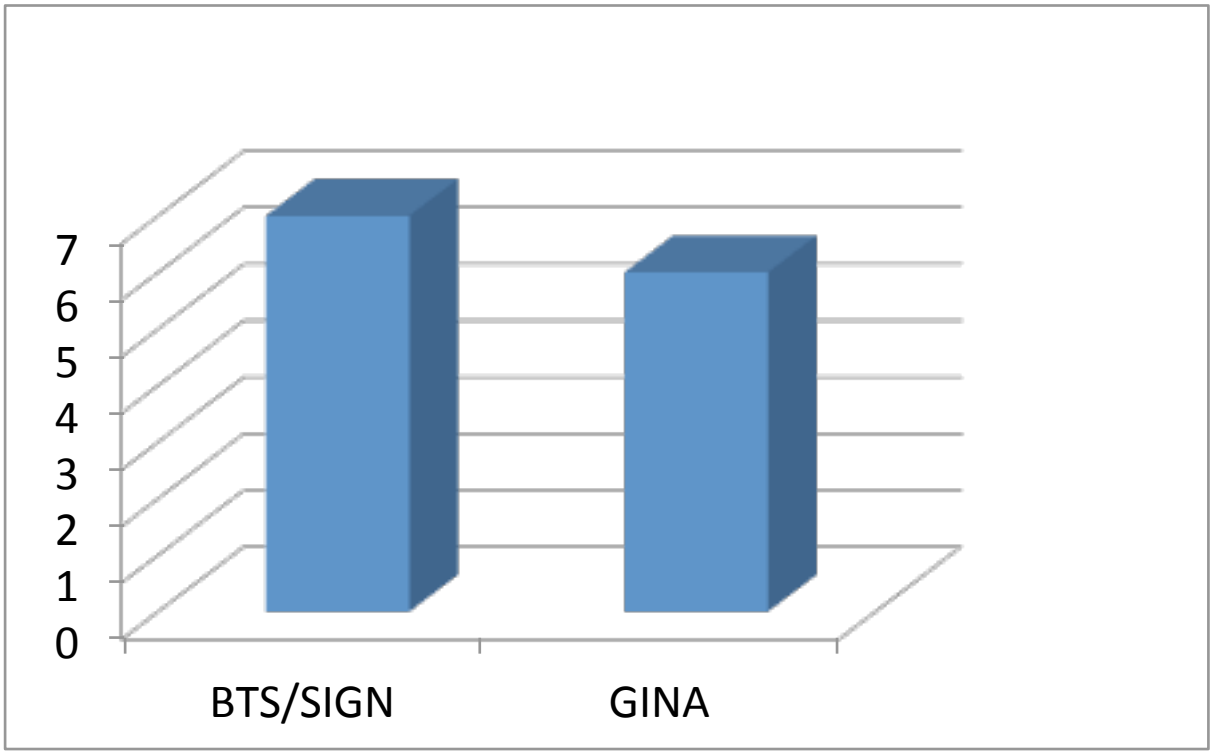
Domain 5: Applicability (both BTS/SIGN and GINA)



Domain 6: Editorial Independence (both BTS/SIGN and GINA)



Domain 6: Overall Assessment (both BTS/SIGN and GINA)



Appendix 11: Description of grades of recommendations for each guideline

Guideline	BTS/SIGN	BTS/SIGN	GINA	GINA
Recommendation grade/level	**Sources of evidence**	**Description of level of evidence**	**Sources of evidence**	**Description of level of evidence**
A ***Note: In BTS/SIGN this is referred to as GRADE A whereas in GINA this is referred to as EVIDENCE A***	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; *or* A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results	1++ High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias 1+ Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias *1 - Meta-analyses, systematic reviews, or RCTs with a high risk of bias*	RCTs and meta-analyses. Rich body of evidence.	Evidence is from endpoints of well-designed RCTs or meta-analyses that provide a consistent pattern of findings in the population for which the recommendation is made. Category A requires substantial numbers of studies involving substantial numbers of participants.
B ***Note: In BTS/SIGN this is referred to as GRADE B whereas in GINA this is referred to as EVIDENCE B***	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 1++ or 1+	2++ High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal	RCTs and meta-analyses. Limited body of data.	Evidence is from endpoints of intervention studies that include only a limited number of patients, post hoc or subgroup analysis of RCTs or meta-analysis of such RCTs. In general, Category B pertains when few randomised trials exist, they are small in size, they were undertaken in a population that differs from the target population of the recommendation, or the results are somewhat inconsistent.
C ***Note: In BTS/SIGN this is referred to as GRADE C whereas in GINA this is referred to as EVIDENCE C***	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 2++	2+ Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal *2 - Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal*	Nonrandomised trials. Observational studies.	Evidence is from outcomes of uncontrolled or non-randomized trials or from observational studies.

Guideline	BTS/SIGN	BTS/SIGN	GINA	GINA
D ***Note: In BTS/SIGN this is referred to as GRADE D whereas in GINA this is referred to as EVIDENCE D***	Evidence level 3 or 4; *or* Extrapolated evidence from studies rated as 2+	3 = non-analytic studies, eg case reports, case series 4 = expert opinion	Panel consensus judgement.	This category is used only in cases where the provision of some guidance was deemed valuable but the clinical literature addressing the subject was insufficient to justify placement in one of the other categories. The Panel Consensus is based on clinical experience or knowledge that does not meet the above listed criteria.
Good practice point	Recommended best practice based on the clinical experience of the guideline development group		NA	

Appendix 12: Data extraction recommendation matrix

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Acute Asthma Management		
Adverse psychosocial and behavioural factors	Healthcare professionals must be aware that patients with severe asthma and one or more adverse psychosocial factors are at risk of death **(Grade B)**	
Patient at risk of near-fatal or fatal asthma	Keep patients who have had a near-fatal asthma attack under specialist supervision indefinitely **(good practice point)**	
Prediction and prevention of severe asthma attack	A respiratory specialist should follow up patients admitted with a severe asthma attack for at least one year after the admission **(good practice point)**	
Criteria for referral	Refer to hospital any patients with features of acute severe or life-threatening asthma **(Grade D)**	
Criteria for admission	Admit patients with any feature of a life-threatening or near-fatal asthma attack **(Grade B)** Admit patients with any feature of a severe asthma attack persisting after initial treatment **(Grade B)** Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from ED unless they meet any of the following criteria, when admission may be appropriate: • still have significant symptoms • concerns about adherence • living alone/socially isolated • psychological problems • physical disability or learning difficulties • previous near-fatal asthma attack • asthma attack despite adequate dose steroid tablets pre-presentation • presentation at night • pregnancy **(Grade C)**	

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Treatments - acute asthma in adults		
Oxygen	Give supplementary oxygen to all hypoxemic patients with acute severe asthma to maintain a SpO_2 level of 94–98%. Lack of pulse oximetry should not prevent the use of oxygen **(Grade C)**	
β2 agonist bronchodilators	Use high-dose inhaled β_2 agonists as first line agents in patients with acute asthma and administer as early as possible. Reserve intravenous β_2 agonists for those patients in whom inhaled therapy cannot be used reliably **(Grade A).** In hospital, ambulance and primary care, nebulisers for giving nebulised β_2 agonist bronchodilators should preferably be driven by oxygen **(Grade A)** In patients with acute asthma with life-threatening features the nebulised route (oxygen-driven) is recommended **(good practice point).** In severe asthma that is poorly responsive to an initial bolus dose of β_2 agonist, consider continuous nebulisation with an appropriate nebulizer **(Grade A)**	
Steroid therapy	Give steroids in adequate doses in all cases of acute asthma attack **(Grade A)** Continue prednisolone 40–50 mg daily for at least five days or until recovery **(good practice point)**	
Ipratroprium Bromide	Add nebulised ipratropium bromide (0.5 mg 4–6 hourly) to β_2 agonist treatment for patients with acute severe or life-threatening asthma or those with a poor initial response to β_2 agonist therapy **(Grade B)**	

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Magnesium Sulphate	Nebulised magnesium sulphate is not recommended for treatment in adults with acute asthma **(Grade A)** Consider giving a single dose of IV magnesium sulphate to patients with acute severe asthma (PEF <50% best or predicted) who have not had a good initial response to inhaled bronchodilator therapy **(Grade B).** Magnesium sulphate (1.2–2 g IV infusion over 20 minutes) should only be used following consultation with senior medical staff **(good practice point).**	
Intravenous aminophylline	Use IV aminophylline only after consultation with senior medical staff **(good practice point)**	
Antibiotics	Routine prescription of antibiotics is not indicated for patients with acute asthma **(Grade B)**	
Heliox	Heliox is not recommended for use in patients with acute asthma outside a clinical trial setting **(Grade B)**	
Referral to Intensive Care	In patients with acute severe or life-threatening asthma, anaesthetists and intensivists should be notified as soon as possible if there is no improvement in or deterioration of asthma **(good practice point)** All patients transferred to intensive care units should be accompanied by a doctor suitably equipped and skilled to intubate if necessary **(Grade C)**	
Non-invasive ventilation	Non-invasive ventilation (NIV) should only be considered in an ICU or equivalent clinical setting **(good practice point)**	

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Further investigation and monitoring	Measure and record PEF 15–30 minutes after starting treatment, and thereafter according to the response. Measure and record PEF before and after nebulised or inhaled β_2 agonist. **(good practice point).** Record oxygen saturation by oximetry and maintain arterial SpO_2 at 94–98%. **(good practice point).** Repeat measurements of blood gas tensions within one hour of starting treatment if: • the initial PaO_2 is <8 kPa unless SpO_2 is >92%; or • the initial $PaCO_2$ is normal or raised; or • the patient's condition deteriorates **(good practice point)** Measure them again if the patient's condition has not improved by 4–6 hours **(good practice point)** Measure and record the heart rate **(good practice point)** Measure serum potassium and blood glucose concentrations **(good practice point)** Measure the serum theophylline concentration if aminophylline is continued for more than 24 hours (aim at a concentration of 10–20 mg/l or 55–110 mol/l) **(good practice point)**	
Follow Up	It is essential that the patient's primary care practice is informed within 24 hours of discharge from the emergency department or hospital following an asthma attack. Ideally this communication should be directly with a named individual responsible for asthma care within the practice, by means of fax or email **(good practice point)**	
β_2 agonist delivery Inhaler Devices		
β_2 agonist delivery - Inhaler devices	Adults with mild and moderate asthma attacks should be treated with a pMDI + spacer with doses titrated according to clinical response **(Grade A)**	

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Factors contributing to difficult asthma		
Allergy	In patients with difficult asthma and recurrent hospital admission, allergen testing to moulds should be performed **(Grade C)**	
Treating modifiable risk factors to reduce exacerbations		Exacerbation risk can be reduced by optimising asthma medications, and by identifying and treating modifiable risk factors
		Risk Factor: Any patient with >= risk factor for exacerbations (including poor symptom control) Treatment Strategy: • Ensure patient is prescribed regular ICS-containing controller **(Evidence A)** • Ensure patient has a written action plan appropriate for their health literacy **(Evidence A)** • Review patient more frequently than low risk patients **(Evidence A)** • Check inhaler technique and adherence frequently **(Evidence A)** • Identify any modifiable risk factors **(Evidence D)**
		Risk Factor: >=1 severe exacerbation in last year Treatment Strategy: • consider alternative controller regimes to reduce exacerbation risk e.g. ICS/formoterol maintenance and reliever regimen **(Evidence A)** • consider stepping up treatment if no modifiable risk factors **(Evidence A)** • identify any avoidable triggers for exacerbations **(Evidence C)**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
		Risk Factor: Exposure to tobacco smoke Treatment Strategy: • encourage smoking cessation by patient family; provide advice and resources **(Evidence A)** • consider higher dose of ICS if asthma poorly-controlled **(Evidence B)**
		Risk Factor: Low FEV_1 especially if <60% predicted Treatment Strategy: • Consider trial of 3 months treatment with high dose ICS and/or 2 weeks OCS **(Evidence B)** • Exclude other lung disease e.g. COPD **(Evidence D)** • Refer for expert advice if no improvement **(Evidence D)**
		Risk Factor: Obesity Treatment Strategy: • Strategies for weight reduction **(Evidence B)** • Distinguish asthma symptoms from symptoms due to deconditioning mechanical restriction and/or sleep apnoea **(Evidence D)**
		Risk Factor: Major psychological problems Treatment Strategy: • arrange mental health assessment **(Evidence D)** • help patient to distinguish between symptoms of anxiety and asthma; provide advice about management of panic attacks **(Evidence D)**
		Risk Factor: Major socioeconomic problems Treatment Strategy: • Identify most cost-effective ICS based regimen **(Evidence D)**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
		Risk Factor: Confirmed food allergy Treatment Strategy: • Appropriate food avoidance; injectable epinephrine **(Evidence A)**
		Risk Factor: Allergen exposure if sensitized Treatment Strategy: • Consider trial of simple avoidance strategies; consider cost **(Evidence C)** • Consider step up of controller treatment **(Evidence D)** • The efficacy of allergen immunotherapy in asthma is limited **(Evidence A)**
		Risk Factor: Sputum eosinophilia (limited centres) Treatment Strategy: • Increase ICS dose independent of level of symptom control **(Evidence A)**
Specialist Settings/ Populations		

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Acute asthma management in pregnancy	Give drug therapy for acute asthma as for non-pregnant patients including systemic steroids and magnesium sulphate **(Grade C)** Deliver high flow oxygen immediately to maintain saturation 94–98% **(Grade D)** Acute severe asthma in pregnancy is an emergency and should be treated vigorously in hospital **(Grade D)** Continuous fetal monitoring is recommended for acute severe asthma. **(good practice point)** For women with poorly controlled asthma during pregnancy there should be close liaison between the respiratory physician and obstetrician, with early referral to critical care physicians for women with acute severe asthma. **(good practice point)**	ICS prevent exacerbations of asthma during pregnancy **(Evidence A)** and cessation of ICS during pregnancy is a significant risk factor for exacerbations **(Evidence A)** On balance given the evidence in pregnancy for adverse outcomes from exacerbations **(Evidence A)** and for safety of usual doses of ICS and LABA **(Evidence A)** a low priority should be placed on stepping down treatment (however guided) until after delivery **(Evidence D)**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Acute asthma management in primary care		*Oxygen* In severe exacerbations, controlled low flow oxygen therapy using pulse oximetry to maintain saturation at 93-95% is associated with better physiological outcomes than with high flow 100% oxygen therapy **(Evidence B).** However, oxygen therapy should not be withheld if pulse oximetry is not available **(Evidence D).** *Inhaled short acting β_2 agonists* For mild to moderate exacerbations, repeated administration of inhaled SABA (up to 4-10 puffs every 20 minutes for the first hour) is usually the most effective and efficient way to achieve rapid reversal of airflow limitation **(Evidence A).** Delivery of SABA via pMDI and spacer leads to a similar improvement in lung function as delivery via nebulizer **(Evidence A)**; however acute severe asthma were not included in these studies. *Controlled oxygen therapy (if available)* Controlled or titrated oxygen therapy gives better clinical outcomes than high-flow 100% oxygen therapy **(Evidence B).** *Systemic corticosteroids* OCS should be given promptly especially if the patient is deteriorating or had already increased their reliever and controller medications before presenting **(Evidence B)** The recommended dose for adults is 1mg prednisolone/ kg/day or equivalent up to a maximum of 50 mg/day. OCS should usually be continued for 5-7 days **(Evidence B).**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Treatment in acute care settings such as the emergency department		*Inhaled short acting β_2 agonists* Inhaled SABA therapy should be administered frequently for patients presenting with acute asthma. The most cost effective and efficient delivery is by pMDI with a spacer **(Evidence A).** There is no evidence to support the routine use of intravenous β_2 agonists in patients with severe asthma exacerbations **(Evidence A).** *Systemic corticosteroids* Systemic corticosteroids speed resolution of exacerbations and prevent relapse and should be utilized in all but the mildest exacerbations in adults **(Evidence A).** Dosage: daily doses of OCS equivalent to 50mg prednisolone as a single morning dose or 200 mg hydrocortisone in divided doses are adequate for most patients **(Evidence B).** Duration: 5 and 7 day courses in adults have been found to be as effective as 10 and 14 day courses respectively **(Evidence B).** Evidence from studies in which all patients were taking maintenance ICS after discharge suggests that there is no benefit in tapering the dose of OCS, either in the short term or over several weeks **(Evidence B).** Evidence from studies in which all patients were taking maintenance ICS after discharge suggests that there is no benefit in tapering the dose of OCS either in the short term or over several weeks **(Evidence B).** *Inhaled corticosteroids* Within the emergency department: high dose ICS given within the first hour after presentation reduces the need for hospitalization in patients not receiving systemic corticosteroids **(Evidence A).** When given in addition to systemic corticosteroids evidence is conflicting **(Evidence B).**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
		On discharge home: the majority of patients should be prescribed regular ongoing ICS treatment since the occurrence of a severe exacerbation is a risk factor for future exacerbations **(Evidence B).** ICS containing medications significantly reduce the risk of asthma related death or hospitalization **(Evidence A).** There was some evidence however that post discharge ICS were as effective as systemic corticosteroids for milder exacerbations but the confidence limits were wide **(Evidence B).** *Other treatments:* *Magnesium* Intravenous magnesium sulfate is not recommended for routine use in asthma exacerbations; however when administered as a 2g infusion over 20 minutes it reduces hospital admissions in some patients including adults with FEV_1 <25-30% predicted at presentation **(Evidence A).** While the overall efficacy of this practice is unclear pooled data from three trails suggest possible improved pulmonary function in those with severe asthma exacerbations (FEV_1 <50% predicted) **(Evidence B)** *Helium oxygen therapy* A systematic review of studies comparing helium oxygen with air oxygen suggests there is no role for this intervention in routine care **(Evidence B).** *Non-invasive ventilation* If NIV is tried the patient should be monitored closely **(Evidence D)**. It should not be attempted in agitated patients and patients should not be sedated in order to receive NIV **(Evidence D).**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Follow up after emergency department presentation or hospitalization		After emergency department presentation comprehensive intervention programs that include optimal controller management inhaler technique and elements of self-management education (self-monitoring, written action plan and regular review) are cost effective and have shown significant improvement in asthma outcomes **(Evidence B).**
Self-Management		
Supporting self-management	A hospital admission represents a window of opportunity to review self-management skills. No patient should leave hospital without a written personalised asthma action plan ***(good practice point)*** An acute consultation offers the opportunity to determine what action the patient has already taken to deal with the asthma attack. Their self-management strategy may be reinforced or refined and the need for consolidation at a routine follow up considered ***(good practice point)*** A consultation for an upper respiratory tract infection or other known trigger is an opportunity to rehearse with the patient their self-management in the event of their asthma deteriorating ***(good practice point)*** Education should include personalised discussion of issues such as trigger avoidance and achieving a smoke-free environment to support people and their families living with asthma ***(good practice point)*** Brief simple education linked to patient goals is most likely to be acceptable to patients ***(good practice point)***	
Self-management in secondary care	Prior to discharge inpatients should receive written personalised asthma action plans given by health care professionals with expertise in providing asthma education **(Grade A)**	

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Self-management in ethnic minority groups	Culturally appropriate supported self-management education should be provided for people with asthma in ethnic minority groups. Addressing language barriers is insufficient ***(Grade B)*** Consideration should be given to: • translation of materials into community languages with ethnically appropriate pictures • asthma educators fluent in community languages • identifying culturally appropriate support agencies within the local community • inclusion of culturally specific beliefs and practices • reference to culturally appropriate role models • involvement of a local community health worker to support clinical teams ***(good practice point)***	
Self-management of worsening asthma and exacerbations		*Inhaled corticosteroids* In placebo controlled trials temporarily doubling the dose of ICS was not effective **(Evidence A)** In adult patients with an acute deterioration high dose ICS for 7-14 days (500-1600mcg BDP-HFA equivalent) had an equivalent effect to a short course of OCS **(Evidence A)** *Combination low dose ICS (budesonide or beclometasone) with rapid onset LABA (formoterol)* The combination of rapid onset LABA (formoterol) and low dose ICS (budesonide or beclomethasone) in a single inhaler as both the controller and reliever medication is effective in improving asthma control and in at risk patients reduces exacerbations requiring OCS and hospitalizations **(Evidence A).** The combination ICS/formoterol inhaler may be taken up to a maximum total formoterol dose of 72 mcg in a day **(Evidence A).**

<table>
<tr><th>Context/Category</th><th>BTS/SIGN - Recommendations</th><th>GINA - Recommendations</th></tr>
<tr><td>Self-management of worsening asthma in adults with a written asthma action plan</td><td></td><td>
<table>
<tr><th>Medication</th><th>Short term change (1-2 weeks) for worsening asthma</th><th>Evidence Level</th></tr>
<tr><td>Increase usual reliever:
Short acting β_2 agonist (SABA)

Low dose ICS/ formoterol</td><td>
Increase frequency of SABA use
For pMDI add spacer

Increase frequency of reliever use (maximum formoterol total 72 mcg/day)</td><td>
A
A

A</td></tr>
<tr><td>Increase usual controller:
Maintenance and reliever ICS/ formoterol</td><td>
Continue maintenance ICS/ formoterol and increase reliever ICS/formoterol as needed (max formoterol total 72mcg/day)</td><td>
A</td></tr>
<tr><td>Maintenance ICS with SABA as reliever</td><td>At least double ICS; consider increasing ICS to high dose (maximum 2000 mcg/day BDP equivalent)</td><td>B</td></tr>
<tr><td>Maintenance ICS/ formoterol with SABA as reliever</td><td>Quadruple maintenance ICS/formoterol (maximum formoterol 72 mcg/day</td><td>B</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Context/Category</th><th>BTS/SIGN - Recommendations</th><th colspan="3">GINA - Recommendations</th></tr>
<tr><td></td><td></td><td>Maintenance ICS/ salmeterol with SABA as reliever</td><td>Step up to higher dose formulation of ICS/salmeterol or consider adding a separate ICS inhaler (to maximum total 2000 mcg/day BDP equivalent)</td><td>D</td></tr>
<tr><td></td><td></td><td>Add oral corticosteroids (OCS) and contact doctor:
OCS (prednisone or prednisolone)</td><td>Add OCS for severe exacerbations (E.g. PEF or FEV_1 <60% personal best or predicted) or patient not responding to treatment over 48 hours

Adults: prednisolone 1mg/ kg/day (maximum 50 mg) usually for 5-7 days.

Tapering is not needed if OCS are prescribed for <2 week</td><td>A

D

B</td></tr>
</table>

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
		Other combination ICS/LABA controllers For adults taking combination ICS/LABA as a fixed dose maintenance controller medication, the ICS dose may be increased by adding a separate ICS inhaler **(Evidence D).** More research is needed to standardize this strategy. *Leukotriene receptor antagonists* For patients using a leukotriene receptor antagonist (LTRA) as their controller there are no specific studies about how to manage worsening asthma. Clinician judgement should be used **(Evidence D).** *Oral corticosteroids* For most patients the written asthma action plan should provide instructions for when and how to commence OCS. Typically a short course of OCS is used (e.g. 40-50 mg/day usually for 5-7 days, **(Evidence B)** for patients who: - fail to respond to an increase in reliever and controller medication for 2-3 days - deteriorate rapidly or who have a PEF or FEV_1 <60% of their personal best or predicted value - have a history of sudden severe exacerbations Patients should contact their doctor if they start taking OCS **(Evidence D).**

Context/Category	BTS/SIGN - Recommendations	GINA - Recommendations
Follow up after a self-managed exacerbation		After a self-managed exacerbation patients should see their primary care health care provider for a semi-urgent review (e.g. within 1-2 weeks) for assessment of symptom control and additional risk factors for exacerbations, and to identify the potential cause of the exacerbation. The written asthma action plan should be reviewed to see if it met the patient's needs. Maintenance controller treatment can generally be resumed at previous levels 2-4 weeks after the exacerbation (**Evidence D**) unless the history suggests that the exacerbation occurred on a background of long-term poorly controlled asthma. In this situation, provided inhaler technique and adherence have been checked a step up in treatment is indicated.

Appendix 13 Tool 13: Evaluation Sheet – search and selection of evidence

"Acute adult asthma management"	Guideline 1: BTS/SIGN				Guideline 2: GINA			
	Yes	**Unsure**	**No**	**Comment**	**Yes**	**Unsure**	**No**	**Comment**
Overall was the search for evidence comprehensive?	**Y**				**Y**			
The author had a clearly focused question (population, intervention, outcome)	Y				Y			
Appropriate databases were searched for source guidelines	Y				Y			
Internet sites were searched for source guidelines	Y					U		Not reported
Years covered in search	Y				Y			
Languages covered in search		U		Not reported	Y			English
Keywords used	Y				Y			
Combinations of keywords	Y				Y			
Detailed search strategies are provided with the guidelines	Y						N	
Snowball methods were used		U		Not reported		U		Not reported
A hand search of the reference lists was completed			N	p.19 SIGN 50		U		Not reported
Local experts and/or societies were asked for guideline recommendations		U		Not specific to asking for recommendations		U		Not specific to asking for recommendations

	Guideline 1: BTS/SIGN				Guideline 2: GINA			
	Yes	**Unsure**	**No**	**Comment**	**Yes**	**Unsure**	**No**	**Comment**
Overall was bias in the selection of articles avoided?		**U**				**U**		
Inclusion and exclusion criteria reported		U		Not explicit		U		Not explicit
The number of persons who selected and analysed the data is documented	Y			Number of people who analysed was 2; selection not reported	Y			p.vi 2 members evaluate and ans. Q's on scientific impact
The procedure to solve disagreement is described	Y			SIGN 50	Y			Consensus/Voting @ meetings
The number of references analysed is documented			N				N	
The number of excluded references is documented			N				N	
The reasons for excluding references are given			N				N	
The criteria for inclusion and exclusion are clinically & methodologically valid		U		I & E criteria not explicit		U		I & E criteria not explicit
The reasons for exclusion conform to the selection and exclusion criteria		U		Not reported		U		Not reported
The process for selection of evidence is adequately described			N				N	
	Comment Followed SIGN 50; actual process from searching evidence to extracting data in evidence tables not reported; no PRISMA diagram				**Comments** The actual process from searching the evidence to extracting data in the evidence tables was not reported; no PRISMA diagram			

Appendix 14: Tool 14: Evaluation sheet – scientific validity of guidelines

(Consistency between evidence, its interpretation and recommendations)

Health Question – *"Acute asthma management in adults"*	**Guidelines 1: BTS/SIGN**				**Guideline 2: GINA**			
	Yes	**Unsure**	**No**	**Comment**	**Yes**	**Unsure**	**No**	**Comment**
Overall the evidence was valid	**Y**				**Y**			
Given the search strategy, the risk that relevant evidence has been missed is low	Y					U		Complete search strategy not explicit
The criteria for selecting the evidence is explicit	Y				Y			
Settings and protocols of selected studies fit with the health question	Y			Yes and if different reported	Y			
Outcomes were clinically sound (e.g. duration of disease-free survival might be considered too weak as evidence compared to overall survival)	Y				Y			
The criteria used for assessing the quality and validity of the selected studies are adequately reported (type of studies, randomization methods, patient's retention in groups etc.)	Y				Y			
The risk that biased evidence has been reported is low	Y			Evidence clearly presented	Y			Evidence clearly presented
When a meta-analysis was performed, statistical analyses were appropriate. Sensitivity analysis and test of heterogeneity was performed				N/A				N/A

Health question – *"Acute asthma management in adults"*	**Guideline 1: SIGN/BTA**				**Guideline 2: GINA**			
	Yes	**Unsure**	**No**	**Comment**	**Yes**	**Unsure**	**No**	**Comment**
Coherence between the evidence and recommendations	**Y**				**Y**			
The evidence was direct. Patients and interventions included in the studies were comparable to those targeted by the recommendations	Y				Y			
Conclusions were supported by data and/or the analysis; results were consistent from study to study. When inconsistencies existed in data, considered judgement was applied and reported.	Y				Y			
The conclusions are clinically relevant. (Statistical significance is not always equal to clinical significance)	Y				Y			
The conclusion derived from data point to effectiveness/ineffectiveness of the intervention and the recommendations are written accordingly	Y				Y			
There is some justification to recommend/not recommend the intervention even though the evidence is weak	Y				Y			
The hierarchy of strength of evidence is adequately described	Y				Y			
Overall, the scientific quality of the recommendations do not present risks of bias	**Y**				**Y**			
The strength of evidence attributed to the recommendations is adequately described and justified	Y				Y			
Risks and benefits have been weighed	Y				Y			
	Comments				**Comments**			

Appendix 15: Tool 15: Evaluation sheet – Acceptability/Applicability

Health Question – Acute asthma management in adults	Guidelines 1: SIGN/BTA				Guideline 2: GINA			
	Yes	**Unsure**	**No**	**Comment**	**Yes**	**Unsure**	**No**	**Comment**
Overall the recommendations are acceptable	Y				Y			
The strength of evidence and the magnitude of effect adequately support the grade of the recommendations	Y				Y			
There is sufficient benefit of the intervention compared with other available management	Y				Y			
The recommendations are compatible with the culture and values in the setting where it is to be used	Y				Y			
Overall the recommendations are applicable	Y				Y			
The intervention is applicable to the patients in the context of use	Y				Y			
The intervention/equipment is available in the context of use	Y				Y			
The necessary expertise is available in the context of use	Y				Y			
There are no constraints, legislation, policies, or resources in the health care setting of use that would impede the implementation of the recommendations	Y			There might be some implications for smaller hospitals in terms of resources for example recommendations for referral and transfer to ICU which may need consideration / management by specific hospital groups.	Y			
	Comments				**Comments**			

Appendix 16: Glossary of Abbreviations

ABG	Arterial blood gas
AGREE 11	Appraisal of Guidelines for Research and Evaluation
AMU	Acute Medical Unit
AMAU	Acute Medical Assessment Unit
BUN	Blood Urea Nitrogen
BTS	British Thoracic Society
BVM	Bag Valve Mask
CAG	Clinical Advisory Group
CCM	Chronic Care Model
CEO	Chief Executive Officer
CEU	Clinical Effectiveness Unit
CF	Cystic Fibrosis
CMO	Chief Medical Officer
CNS	Clinical Nurse Specialist in Respiratory care
COAX	Cost of Asthma Exacerbations
COPD	Chronic Obstructive Pulmonary Disease
CO_2	Carbon Dioxide
CPI	Consumer Price Index
CPG	Clinical Practice Guidance
CPD	Continuous Professional Development
CSO	Central Statistics Office
CXR	Chest X-ray
DALY	Disability Adjusted Life year
DARE	Database of Abstracts of Reviews and Effects
DCU	Dublin City University
DMP	Disease Management Programme
DOB	Date of Birth
DOH	Department of Health
DPS	Drug Payment Scheme
EBP	Evidence Based Practice
ECG	Electrocardiogram
ED	Emergency Department
EFR	Emergency First Response
EU/EN 13826	European Union Scale (for peak flow meters)
FBC	Full Blood Count
FEV_1	Forced Expired Volume in one second
GDG	Guideline Development Group
GINA	Global Initative for Asthma
GMS	General Medical Services
GP	General Practitioner
GPOOH	GP Out of Hours
H^+	Hydrogen acid
HIPE	Hospital In-patient Enquiry
HSE	Health Service Executive
IARS	Irish Association of Respiratory Scientists
ICER	Incremental Cost Effectiveness Ratio
ICGP	Irish College of General Practitioners
ICU	Intensive Care Unit
IM	Intramuscular
ITS	Irish Thoracic Society
IV	Intravenous
kg	kilogram

MAU	Medical Assessment Unit
MOCA	Model of Care for Asthma
mg	miligram
min	minute
NCEC	National Clinical Effectiveness Committee
NCG	National Clinical Guideline
NCPA	National Clinincal Programme for Asthma
NHS	National Health Service
NIV	Non-invasive ventilation
NMBI	Nursing and Midwifery Board of Ireland
O_2	Oxygen
OOH	GP Out of Hours Service (see GPOOH above)
OPD	Outpatients Department
PEF	Peak Expiratory Flow
pH	Numeric scale used to specify the acidity or alkalinity
PHECC	Pre-Hospital Emergency Care Council
PICO	Population, Intervention, Comparison, Outcome
PN	Practice Nurse
pMDI	pressurised Metered Dose Inhaler
PPP	Purchasing Power Parity
PRISMA	PRospectIve Study on asthMA control
QALY	Quality Adjusted Life Year
RCPI	Royal College of Physicians of Ireland
RCT	Randomised Control Trial
RTI	Respiratory Tract Infection
SABA	Short Acting Beta Agonists
SCr	Serum creatinine
SIGN	Scottish Intercollegiate Guideline Network
SOB	Shortness of Breath
SPO_2	Oxygen Saturation
UCD	University College Dublin
UK	United Kingdom
USA	United States of America
WG	Working Group

Appendix 17: Budget impact assessment[a]

Appendix 17.1. Economic impact report

Key message
This review of the literature on the economic evaluation of the acute asthma management in adults and the budget impact analysis supports the clinical guideline recommendations.

The report was completed by Prof. Patrick Manning, Consultant Respiratory Physician and Clinical Lead for National Clinical Programme for Asthma (NCPA), Noreen Curtin (Programme Manager NCPA 2012-2013) and Michelle O'Neill, Senior Health Economist, Health Technology Assessment Directorate, Health Information and Quality Authority in collaboration with Prof Stephen Lane, Chair (Clinical Advisory Committee-NCAP), Dr. Ina Kelly, Specialist in Public Health Medicine (NCAP), Dr Kathleen Mac Lellan, Director of Clinical Effectiveness, CMO Office, Department of Health and Mr. Gethin White, Clinical Librarian, Health Service Executive (HSE) library services.

Background
The overarching aim of the National Clinical Programme for Asthma (NCPA) is to reduce the morbidity and mortality associated with asthma in Ireland and to improve clinical outcomes and the quality of life for all patients with asthma. A key component is improved management of people with asthma in primary care and thereby avoiding emergency asthma attendance at GP out of hours services (GPOOH – estimated 21,800 adult visits annually) and at hospital ED and in-patient admission services. There is a good scientific rational for this approach and this work has been shown to be effective at international levels with significantly improved outcomes focusing on improving asthma control in the community and thereby reducing asthma morbidity and mortality overall. This includes reduced adult acute asthma attendances at Emergency Departments (currently estimated at about 12,000 adult visits annually), in-patient admissions in hospital (currently about 1,460 adult admissions annually) and accounting for 5,825 acute bed days used, of which 70 patients had an ICU admission utilising 222 ICU bed days. (Hospital In-patient Enquiry - HIPE 2011) Patients with acute asthma exacerbations are at an increased risk of death (currently about 1 per week (most asthma deaths occur in adults)) and 90% of deaths from asthma are preventable. Acute attendances and admissions may have their roots in prior inadequate care in the community and in a lack of patient involvement in controlling symptoms through guided self-management. Poorly controlled asthma is costly; the efforts in the community at primary and specialist care levels should be firmly focused on achieving and maintaining good control in as many patients as possible. As much as a third of the overall cost of managing asthma may be related to emergency attendances, hospitalisation and death, with hospitalisation accounting for between 20 and 25% of the overall cost (5). The Asthma Society of Ireland has estimated the cost of asthma care in the Republic Of Ireland is of the order of €6.5 million and due largely to uncontrolled asthma. Much of this cost relates to adult admissions and the estimated cost in 2005 as identified in an international study to determine the Cost Of Asthma exacerbations (20) was €3,809 per patient per admission but this is equivalent to **€4,733** in 2013. (CSO/CPI for health).

Annual Estimated Cost for 1460 x €4733.2 adult admissions: €6.9m

International research has identified that the majority of hospital admissions for asthma are emergency admissions, of which 70% may have been preventable with appropriate early intervention (21, 22) Many people with asthma have poor control of their condition and in a

a See Appendix 5.4 list of References for Economic Evaluation Literature Review where 'Reference' is indentified in text

large scale survey in the UK reported that around 35% of adults with asthma had had an asthma attack in the previous 12 months (The Health Survey for England found that 30-40% of people with asthma had had an asthma attack in the previous 12 months)(23). Poorly controlled asthma is more expensive than well controlled asthma for the NHS. The annual cost of an NHS patient who has an exacerbation of asthma requiring hospital treatment is likely to be 3.5 times that of a patient who does not. It is expected that it is similar in the Republic of Ireland. Thus, there is significant scope for reducing overall community costs for asthma by improving disease control through implementing a programme of guideline based chronic disease management at primary care level linked when necessary to specialist care for all patients with asthma and appropriate management of exacerbations as outlined in these acute guidelines for adult asthma. This is what is envisaged in the National Model of Care for Asthma.

NCPA Model of Care for Asthma

The NCPA has developed a Model of Care for Asthma (MOCA) which details how physicians, nurses, and other health care professionals will work with engaged patients to make the clinical decisions most appropriate to their circumstances by implementing international evidence-based guideline care in chronic disease as well as acute management; and to collaborate with specialist colleagues in providing a safe, seamless patient experience within the health system in Ireland. MOCA has been approved by the HSE Leadership Team and it is envisaged that it will be published by the end of 2015.

The implementation of the MOCA will ensure that patients with asthma will benefit from being part of a well-managed integrated system of care, coordinated at primary care level and financed to support seamlessness and patient-centeredness.

The team at primary care level will deliver ongoing high quality health care for patients with asthma with 24/7 access to care. This team will be led by an experienced general practitioner (GP) with knowledge and training in asthma care, with a trained practice nurse that will educate, support and enable patients to effectively manage their asthma. The community pharmacist will assist the GP in asthma management by communicating concerns about patient's control and providing patient education on inhaler technique and peak flow monitoring. They will also advise patients on asthma drug therapies and potential drug interactions (medicine use review). GPs will refer patients to the specialist service in secondary care who will assist the GP to manage 'difficult to control' asthma in the community and be responsible for monitoring acute asthma care in ED and acute medical unit (AMU)/ acute medical assessment unit (AMAU).

If necessary, people with asthma will be admitted for acute management and stabilisation in accordance with best practice guidelines. International evidence demonstrates that implementing a national asthma management programme over a number of years can reduce asthma hospitalisations by 50%, cost per patient by 30%, and deaths from asthma by 90% (24).

Implementation Plan for Model of Care for Asthma

Work is currently underway by the NCPA to develop an implementation plan for MOCA. The MOCA identifies implementation to occur in phases. The initial phase will focus on patients (both adults and children) with acute asthma who attend GPOOH services and also those who attend ED and/or are admitted for acute asthma (estimated at about 70,000 in total). Some recommendations such as the use of guidelines and asthma education training are already underway, whereas, other recommendations such as patients attending a structured review as outlined in the Asthma Check document (25) at primary or secondary specialist care have yet to be implemented and thus will likely have resource implications. The annual structured review will require approximately 30 minutes of practice nurse time and 10 minutes of GP time. If spirometry is required additional time should be booked. This structured asthma review will focus on optimising treatment, ensuring institution of inhaled corticosteroid therapy early in asthma management where appropriate, encouraging medication adherence and address underlying

problems with asthma care and management and will include some or all of the following with the patient and/or caregiver:

- Inhaler technique
- Adherence to and understanding of asthma medications
- Self-management education including personal asthma plans and self-monitoring
- Management of co-morbidities and triggers including allergic rhinitis
- Smoking cessation and/or avoidance or exposure to second hand smoke

The Acute Asthma Guidelines for adults

Since the goal of asthma management is to achieve and maintain control of asthma symptoms, which should be achievable in the majority of people with asthma, for most people, the best outcome of on-going effective management of asthma means that they will not experience acute attacks and exacerbations. However for a significant minority, urgent need for healthcare is an unfortunate but often on-going aspect of their asthma. An acute exacerbation requiring hospital attention at Emergency Departments (ED) or in-patient care represents a serious failure of asthma control. In that situation, patients will need to have access to local, easily accessible and competent services in an emergency, which may be their GP practice, GP out-of-hours/ urgent care services (GPOOH), ED and in-hospital care. About 15% of patients relapse following an acute exacerbation, especially if seen in an ED, due to unresolved airway inflammation.

This guideline provides clear guidance for the assessment and treatment of acute asthma in general practice, by paramedic services, the Emergency Department and in the acute hospital for adults. The guideline articulates clear criteria for when patients with acute asthma should be admitted and discharged. The guidelines also mention that if clinical staff fail to assess severity of an acute exacerbation by an objective measurement and under-use corticosteroids it can lead to poor outcomes including avoidable deaths and thus education is required around guideline managed care.

This guideline for adults (along with the NCPA's acute asthma guideline for paediatrics (26)) is a significant management tool, based on current international best practice and will assist in appropriate management and follow up of acute exacerbations of asthma. Patients with an acute exacerbation of asthma are at increased risk of death and readmission for asthma if not managed appropriately. Patients who attend GPOOH, ED and those who are admitted to hospital for acute asthma should be followed up by attending their GP within 2 working days of discharge for ongoing asthma management. International best practice recommends that all patients admitted to hospital should be followed up on discharge from hospital in a medical specialist clinic for 1 year (in conjunction with their GP) until stable.

The implications for service development for acute guideline implementation

- All HSE staff involved with patients experiencing an asthma exacerbation should have appropriate training in arranging rapid assessment for asthma, in all healthcare settings in which patients may attend in an emergency.
- Ambulance staff may be the first health care professionals that people will encounter in an emergency. They need to have the right skills and training to provide support before they can reach more specialist treatment. They also need to be able to distinguish between people who need hospitalisation and those who could safely be redirected to community services.
- GP Out–of-hours (GPOOH) centres are increasingly the first port of call for people experiencing an asthma exacerbation. Therefore medical/nursing staff in these settings need to be as well-trained as in all other settings and in particular need to have close communication with primary care to ensure prompt and appropriate follow-up after the episode. It is particularly important that out-of-hours services are aware of people at greatest risk of having an attack, are knowledgeable and competent in dealing with asthma attacks.

- Hospital staff, including ED and in-patient hospital personnel involved in triage, assessment and management of acute asthma should have the appropriate knowledge and training in acute asthma assessment and ongoing care for this condition.
- There is over-use of nebulisers in acute situations. Delivery of short acting bronchodilators by nebuliser instead of by standard inhaler with a spacer can encourage a reliance on hospital care, and lead to repeat hospital attendances by patients, when delivery using an inhaler and spacer may be adequate. This guideline recommends that Hospital Emergency Departments, GPOOH and urgent care centres do not use nebulisers routinely for treatment of acute attacks, except where appropriate.
- Patients who are admitted to hospital should be managed in a ward where staff, including nurses, have adequate training and experience in monitoring acutely ill asthma patients and are proficient at administering appropriate medications for this.
- Every acute hospital admissions unit should have a senior clinical individual who is responsible for ensuring that asthma care across all departments conforms to the Irish Acute Asthma Attack in Adults Guideline, and to ensure that records and audit processes and outcomes are identified and stored.
- Implementation of bundles of care for acute asthma care to encourage adherence to best practice guidelines is recommended locally.

Economic literature review results

A systematic review of the economic evaluation literature of acute asthma was conducted, the detailed search terms are provided in Table 9 (Search Methodology) and a flow diagram of the retrieved studies in Figure 2, all the studies are listed in the References for Economic Evaluation Literature Review section in Appendix 5.4. Of the 54 studies identified, 34 were excluded from analysis. One was not available, (27) and 33 studies did not report any relevant economic data (28-60). These latter 33 studies reported on drug therapy in a chronic disease management setting leading to better ongoing asthma control outcomes as per Irish current management asthma guidelines (61) based on international evidence-based clinical practice. The outcome of this enhanced control of asthma leads to less asthma exacerbations, out-of-hours GP (GPOOH) attendances, Emergency Department (ED) attendances, hospital/ICU admissions and possibly deaths from acute asthma. This economic analysis is outside the scope of these current acute management guidelines and will be addressed in a future NCEC submission of the chronic management asthma guidelines. The remaining 20 studies (references 62-79) cover a broad range of topics covering five main areas and are closely linked with implementation of the guidelines on acute asthma. These topics include: a) costs of asthma exacerbations and hospital admissions in adult patients with asthma both internationally and in the Republic of Ireland; b) asthma education for healthcare professionals as part of regional and national implementation programmes; c) outcomes of implementation of asthma clinics; d) rationale for prescribing steroids especially inhaled steroids at the time of an exacerbation and; e) the cost of using a multidose inhaler (MDI) reliever with a spacer device for acute asthma compared to the usual wet nebulisation in acute care settings such as hospitals and EDs. The costs presented have been inflated and converted into 2013 values for Ireland using the relevant national Consumer Price Index (CPI) and Purchasing Power Parity (PPP) unless otherwise stated.

A. Costs of asthma exacerbations and hospital admissions (references 62-67)

Cost in the Republic of Ireland were identified in the international observational prospective study to determine the Cost Of Asthma exacerbations (COAX) study (20): This prospective study (20), which was reported in 2006 involved a total of 15 countries including the Republic of Ireland. It assessed the local cost of asthma exacerbations managed in either primary or secondary care. Healthcare resources used were costed using actual values appropriate to each country in local currency and in Euros. Results are presented for exacerbations managed in *primary care* in Brazil, Bulgaria, Croatia, Czech Republic, Hungary, Poland, Russia, Slovakia, Slovenia, Spain and Ukraine, and in *secondary care* in Croatia,

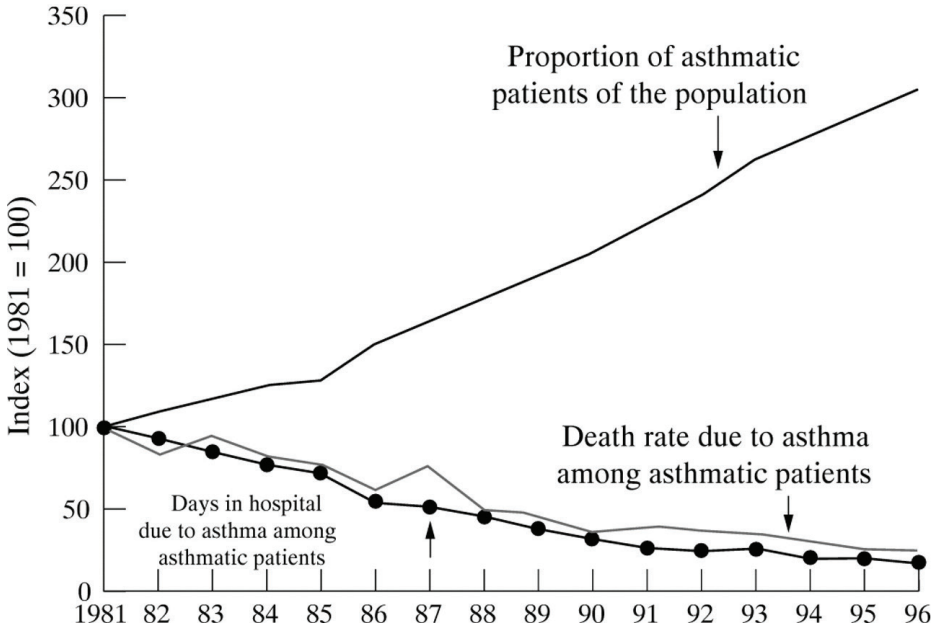
Denmark, **Ireland,** Latvia, Norway, Poland, Russia, Slovakia, Slovenia and Spain. Multiple regression analysis of the 2,052 exacerbations included in the economic analysis showed that the cost of exacerbations was significantly affected by country (P<0.0001). Mean costs were significantly higher in secondary care (€1349) than primary care €445 (P=0.0003). Age was a significant variable (P=0.0002), though the effect showed an interaction with care type i.e. older adults needing hospital care had increased costs compared to younger adults (P<0.0001). As severity of exacerbation increased, so did secondary care costs, though primary care costs remained essentially constant. In conclusion, the study showed that asthma exacerbations are costly to manage, suggesting that therapies able to increase asthma control and reduce the frequency or severity of exacerbations may bring economic benefits, as well as improved quality of life.

In addition, international studies (references 62-66) have identified that asthma exacerbations leading to emergency management and in-patient hospitalisations can be costly through both direct and indirect costs. Direct costs include emergency care, hospital admissions, associated tests and management and the cost varies depending on the asthma exacerbation severity. In a study of 401 asthma patients in northern California USA (published in 2003, data from 1998), the annual average cost of adult hospital admissions was €564 accounting for 15% of costs, In Canada (published in 2013, data in abstract form from 2011), the average hospitalisation costs per acute asthma episode ranged from €306 to €617 and the average costs for ED visit per acute asthma episode ranged from €146 to €184, excluding medication cost. The analysis of the cost of asthma in Spain (which included emergency care, hospital admissions, and tests) showed that the average annual cost of asthma in adults in Spain (published in 2009, data from 2007) comes to €2,275 per patient, considering both direct and indirect costs. The average annual cost per patient to the Spanish National Health Service is €2,021. In both Korea (2012) and the USA (2012), the burden of asthma was higher for patients with poorly controlled asthma and in USA, asthma patients (12-64 years) with exacerbations vs those without exacerbations had significantly higher asthma-related costs [$1740 vs $847, (€1450 vs €700) P<0.0001]. Sixty-eight international studies reviewed between 1966-2008 found that hospitalisation and medications to be the most important cost driver of direct costs. Recommendations from this review included strategies for including education of patients and physicians in asthma assessment and care, and regular follow-up being required to reduce this economic burden of asthma.

B. Asthma education for healthcare professionals (References 24,67,68)

In the early 1990s the Ministry of Social Affairs and Health in Finland (pop. 5.2 million) set up a national asthma programme in conjunction with the Finnish Lung Health Association (24). The main objectives for the programme were improved and early diagnosis of asthma in the population, patient education and self-management, reduction in tobacco exposure and research with a view to stopping the escalating costs of managing the condition. A key goal was an asthma educational programme for key healthcare professionals in the community (GP, practice nurses and pharmacists) and in secondary care. The key to implementation was an effective network of asthma responsible professionals. The main premise was that asthma is an inflammatory disease requiring anti-inflammatory therapy (with inhaled corticosteroids) from the onset. The outcome from the 10 year programme (1994-2004) identified that while the incidence of asthma increased over that time, the burden of asthma to the community decreased considerably through implementing the programme. The number of hospital days fell by 54% from 110,000 in 1993 to 51,000 in 2003, 69% in relation to the number of people with asthma (n=135,363 and 207,757, respectively), with the trend remaining downwards. In 1993, 7,212 patients of working age (9% of 80,133 people with asthma) received a disability pension from the Social Insurance Institution compared with 1,741 in 2003 (1.5% of 116,067 people with asthma). The absolute decrease was 76%, and 83% in relation to the number of people with asthma. The increase in the cost of asthma (compensation for disability, drugs, hospital care, and outpatient doctor visits) ended: in 1993 the costs were €218 million which had fallen to €213.5 million in 2003. Costs per patient per year decreased 36% (from €1,611 to €1,031). The

programme was run by the Finnish Lung Health Association (Filha)[b], and employed one pulmonologist. Overall, the direct extra cost of the programme was €0.65 million including €125,000 from the Finnish Ministry of Social Affairs and Health who gave their political commitment to the programme. The intervention was managed by integrating the tasks into the everyday practice of healthcare staff. The conclusion of the project was that it is possible to reduce the morbidity of asthma and its impact on individuals as well as on society through a co-ordinated programme including health professional **Education on asthma exacerbations**. A similar programme is outlined in detail in the Irish National Clinical Programme for Asthma's Model of Care.



[Asthma statistics in Finland for the period 1981–1996 showing a relative increase in the number of patients entitled to special reimbursement for their drug costs and decreases in the death rate and days in hospital for these patients (index, 1981 = 100)].

Asthma education for emergency department staff can also be effective in improving asthma care. In a study from Kuwait (67) a new policy was implemented in a single acute hospital emergency department (which is planned in Ireland outlined in the National Model of Care for Asthma). This policy was aimed at reducing medical admissions to overcome the problems of a shortage of inpatient beds, overcrowding, rising costs and exhausted resources. A key component was the implementation of disease management guidelines for a number of medical conditions including acute asthma and was prospectively studied over a period of 3 years from introduction of the policy and compared with the 3-year period before the policy was instituted. The outcome was a significant reduction in admission rates after introduction of the new policy with a relative reduction of 49.2% for bronchial asthma.

Internationally hospitalisation and medications were found to be the most important cost driver of direct costs. In an international review of 68 studies between 1966-2008, (68) recommendations were identified which included strategies for including education of patients and physicians in asthma assessment and care, and regular patient follow-up by educated healthcare professionals being required to reduce the economic burden of asthma.

b Filha is a Finnish non-governmental organisation (expert NGO, www.filha.fi)

C. Asthma clinics (References 69-75)

These studies showed that compared with those who received only primary care, patients who received secondary care showed evidence of more appropriate controller treatment. In addition, the disease management programme (DMP) in secondary care is associated with a gain in QALYs compared to usual care (2.7+/-.2 versus 3.4+/-.8), at lower costs (€3,302+/-314 versus €2,973+/-304), thus leading to dominance (69). Organizing health care according to the principles of disease management for adults with asthma has a high probability of being cost-effective and is associated with a gain in QALYs at lower costs (70).

Mogasale et al. investigated the cost-effectiveness of providing asthma education, promotion of self-monitoring of symptoms, regular review of treatment by a medical practitioner and a written asthma action plan to current practice in Australia (71). When a potential $85 million in cost-savings from decreased emergency department visits, GP visits and hospitalisations is taken into account, the ICER was $17,000 per DALY averted. The study concluded that an asthma clinic as an intervention for improving self-management may be cost-effective in Australia if multiple benefits can be achieved.

Victoria Rogers et al. reported on a quality improvement programme evaluatingthe impact of implementing elements of the Chronic Care Model (CCM) (in three clinical sites at Maine Medical Center) (MMC) in the USA (72). This programme was undertaken in order to decrease visits and associated costs connected with asthma hospitalisations and ED visits with yearly comparisons beginning July 2001 (July 1, 2001 through June 30, 2002). They identified patients with asthma from three clinic sites (Family Practice, Internal Medicine, and Paediatrics). These sites implemented an intervention consisting of a redesigned team approach, an emphasis on patient self-management skills, and the use of registries to track populations of patients. It is planned that a similar intervention will be implemented in Ireland at primary and secondary care levels as outlined in the National Model of Care for Asthma. There was a very substantial reduction in asthma-related ED visits and hospitalisations in all three sites varying from 51% in Internal Medical Clinic, 40.7% for the BBCH Paediatric Clinic and 36.5% for the Family Practice Center. The reduction among the clinic patients was far greater than the 5.5% reduction in asthma ED visits and hospitalisations observed for all patients using the MMC during the same time period. The difference in utilization among clinic patients resulted in savings of about €50,000 [US$60,000 x 0.832 = PPP (IRE, 2013)] over the year under review. There was also a moderate reduction in non-asthma related ED visits and hospitalisations for the clinic population.

About 20% or more of adult asthma patients may develop a repeat exacerbation requiring ED attendances and/or early re-admission to hospital within 1 month of discharge (73, 74). Much of this relates to suboptimal discharge management following the initial admission and thus is creating a potentially avoidable burden for patients and medical services. Involvement and follow up in an asthma nurse / respiratory specialist clinic has been shown to reduce re-hospitalisation rates to 0% with asthma nurse specialist input (75). If admitted to hospital for acute asthma it is recommended that patients be followed up in a specialist medical outpatient department (OPD) for 1 year until stable (adult asthma patients following an acute exacerbation may not followed up in the medical OPD on discharge). Occasionally patients may be followed in specialist medical OPD indefinitely if they have more severe or difficult to control asthma.

D. MDI reliever with spacer device for acute asthma compared to wet nebulisations (References 76-77)

Cates et al. evaluated the use of the reliever therapy for acute asthma as MDU or wet nebulisation and searched the Cochrane Airways Group Trial Register and reference lists of articles (76). This search included a total of 1,897 children and 729 adults in 39 randomised control trials. Thirty-three trials were conducted in the emergency room and equivalent community settings, and six trials were on in-patients with acute asthma (207 children and 28

adults). Nebuliser delivery produced outcomes that were similar to metered-dose inhalers delivered by spacer in adults. Method of delivery of inhaled β_2 agonists reliever medication did not appear to affect hospital admission rates. The MDI/spacer can also be cheaper and thus may be a more economical alternative to wet nebuliser delivery. Dhuperet al. (77) reported that demonstration of equivalent efficacy of β_2 agonist delivery using a metered dose inhaler (MDI) with a spacer device compared to using a wet nebuliser in asthma patients. However, the median cost of treatment per patient was $10.11 (SD $10.03-$10.28) vs. $18.26 (SD $9.88-$22.45) in the spacer and nebuliser groups, respectively ($p < 0.001$). They concluded that there is no evidence of superiority of nebuliser to MDI/spacer β_2 agonist delivery for emergency management of acute asthma in this inner-city adult population. Thus the MDI/spacer may be a more economical alternative to wet nebuliser delivery in patients other than those with severe exacerbations. This evidence supports Recommendation 11 of the *Management of an Acute Asthma Attack in Adults* Guideline.

Appendix 17.2. Budget-Cost implications for implementation of acute adult guidelines

The cost implications for implementation of these guidelines in adults were reviewed as follows:

Budget impact of the proposed guidelines
The cost impact analysis focuses on two (2) costing areas:

1. **Staff training**
   The main costs for guideline implementation is the costs associated with structured training for clinical staff in hospital and GPOOH settings on acute asthma guideline managed care. It is critical that medical staff involved with acute asthma patients have the knowledge and training to manage these patients appropriately.

2. **Possible additional cost implications arising from implementing the guidelines**
   Additional costs that have been reviewed but are essentially either cost neutral or are associated with implementation of an overall Asthma Model of Care Chronic Disease Management Programme for primary care linked to specialist care, include the following:
   - Recommendation that a spacer device is used with a pressurized multidose inhaler (*p*MDI) inhaler in mild-moderate asthma exacerbations rather than wet nebulisation for salbutamol bronchodilation where possible.
   - Recommendations on medications e.g. inhaled steroids and oral steroids in acute asthma exacerbations.
   - Recommendation of follow up with GP within 2 working days of discharge from ED.
   - Recommendations on follow up in the medical specialist/nurse led OPD clinic for 1 year for patients admitted to hospital with acute asthma following discharge.
   - Recommendation that all patients have a peak flow meter reading on admission to GPOOH, ED and Hospital.

Costs of staff training on guidelines implementation:
This is the main cost associated with implementation of the acute asthma guideline for adults.

Nurses: Hospital and practice nurses in primary care (PNs) and Out of Hours (OOH) Nurses
The National Asthma Programme and the Asthma Society of Ireland (ASI) have developed an online asthma education programme which is aimed at the healthcare professional. The course contains two components, 6 x 30 minute e-learning modules based on GINA guidelines (these should be completed within 6 months of commencement) and an additional practical workshop (½ day session – 3 hr). This workshop is delivered by Respiratory Clinical Nurse Specialists. The HSE have employed a service level agreement (SLA) with ASI to cover the cost of this e-learning package so there is no direct cost to the person undertaking the training. The SLA cost €29,084 per year from 2011 – 2014 with a total cost of €116,336. This SLA will continue in 2015. However, the SLA with ASI includes time for work on the educational programme along with other aspects (patient information, development of chronic asthma guidelines, national MOC etc.) thus it is not possible to apportion costs to acute asthma guidelines time.

The e-learning training is mandatory for Practice Nurses (PNs) and is optional for nurses/staff working in secondary care. However, all nurses should undertake the ½ day workshop on asthma practical skills (asthma management plans, medications, guidelines implementation and follow up, peak flow readings and inhaler technique).

I. Costs of attendance at training

To cost the staff time for education, an average salary at staff nurse grade (HSE, 2013) was assumed for those attending. This includes staff time attending training and clinical nurse specialist (CNS) time delivering training.

This is envisaged as a once off training cost so that after initial training the onus is on the individual to maintain competence.

II. Cost to deliver training

Total Nurse Costs:

The cost for training the 2,085 nurses [***Hospital and practice nurses in primary care (PNs) and Out of Hours Nurses (OOH)***] targeted as outlined in the National Model of Care for Asthma to attend half day workshop (assume average of 10 staff on workshop). This would require CNS to provide 209 half day workshops at an approximate cost of €26,334 i.e. CNS salary x (209 x 3 hours). The cost for the HSE nurses (excluding the PNs) above to attend a 3 hour workshop is approximately €124,380 and for Out of Hours nurses training €14,670. However, for primary care practice nurses (PNs) training places are included for these nurses to attend when slots are available i.e. as part of the 10 nurses slots (their time to attend is provided by the GP practice). Although staff costs are quantified above, these are an opportunity cost in that staff are released from other duties to attend/deliver training[c].

NCHD training

This is undertaken by the consultant specialists as part of medical education (undergraduate and post graduate). **There is no implementation cost for this.**

Consultants training

Updated training on their own time assisted by local Asthma Medical/Respiratory Consultant Lead. (This is completed in non-specialist consultant own time and is not included in costs). Consultants are funded for CME updates as part of their contract of employment. Each acute hospital site admitting adult patients with acute asthma have an assigned designated local lead (approx. 35). It is envisaged that the local Asthma Medical/Respiratory Consultant lead may have to provide 3, three hourly teaching sessions per year. The hourly cost for local asthma consultant lead is estimated at €88/hour[d]. Each session (including preparation time) estimated costing €264.00.

Opportunity Local Asthma Lead costs €264 x 3 x 35 sites = €27,720 / year

GP training

An on-line education programme has been developed by the ICGP in conjunction with the National Clinical Programme for Asthma.
Access is free of charge for members of the ICGP.
(This is completed in one's own time and not included in costs).

GP practice nurse training

While there are no costs for PNs to partake in the training there may be some opportunity cost to the GP practice in that staff may need to be released from other duties from the practice so they can attend the half day practical training
This is a cost to the GP practice and not the HSE.

c Salary formula as per Budget Impact Analysis of Health Technologies in Ireland was used for both grades and formula as per Regulatory Impact Analysis used with adjustment for nursing hours.

d In line with consolidated salary scales in accordance with clause 2.31 of the Haddington Road agreement http://www.hse.ie/eng/staff/Benefits_Services/pay/nov13.pdf

Pharmacist training

In addition a number of pharmacists and other health professionals have registered for this programme.

This is completed in the pharmacist's own time and not included in the costs of the programme.

Pre-hospital emergency care practitioner training

Pre-hospital emergency care practitioners have ongoing educational programmes which include acute asthma management and are included in these guidelines.
There is no extra cost envisaged with this training.

Table 6 Cost of attendance for training HSE associated staff

Profession	Training Number	Salary Scales	Total cost
Nurses (HSE) (hospital based in ED, AMU-AMAU Departments)	1,382	€30/hr x 3hr = €90 per training session (1,382 HSE hospital nurses x €90 = €124,380)	€124,380
Practice nurses (primary care)	540	No salary costs to HSE (GP)	No HSE salary cost
GP out of hours (GPOOH) nurses (HSE supported)	163	As per HSE nursing above €90 x 163 = €14,670	€14,670
Local Medical/Respiratory Consultant Hospital Asthma Lead may have to provide up to 3 teaching sessions per year.	35 sites	€264 x3 x35 sites = €27,720	€27,720
Clinical Nurse Specialist (CNS) Respiratory – costs as trainers	2,085 (HSE, PNs, OOH nurses) Nurses for training	Training session is 3hrs = €126 (@ €42/hour) There are 209 sessions x 3 hours required to complete training of staff €126 x 209 = €26,334	€26,334

Cost of attendance at training for HSE staff **= €193,104**

Table 7 Cost of attendance at training for other staff

Profession	Numbers for training	Salary Scales	Total cost
NCHD training in acute asthma			None (as part of PG training)
GP training			As part of ICGP CME/ CPD
GP practice nurse			No cost to HSE but there is a cost to GP practice for time
Pharmacist			None
Pre-hospital emergency care practitioners training			None (as part of PG training)

Possible additional cost implications

Possible additional cost implications arising from implementing the guidelines recommendations include:

A. Recommendation that a spacer device is used with a pressurized multidose inhaler (pMDI) inhaler in mild-moderate asthma exacerbations rather than wet nebulisation for salbutamol bronchodilation where possible.

The acute guidelines recommend that as standard practice that the reliever salbutamol, be given for relief of bronchospasm. However, in many cases current practice is that this is given by a nebuliser and face mask usually in an acute setting such as GPOOH or hospital ED. However, international guidelines have recommended for some time that in cases of mild to moderate exacerbations salbutamol should be given as a pMDI using a spacer device (either Volumatic® or disposal once off paper spacer). The rationale for this approach is that patients will learn to treat acute asthma symptoms using their own salbutamol inhaler at home rather than attend needlessly to ED or GPOOH for nebulisation therapy. In addition, as part of the proposed *Asthma Watch* chronic disease management (CDM) structured review patient education will focus on managing exacerbations with a pMDI and spacer with advice as to when to attend ED and GPOOH if this is ineffective. The pMDI and the nebuliser devices are equally effective for the delivery of bronchodilators in the acute care setting. However, in such cases where pMDI and spacers are used, a wet nebuliser will need to be available in GPOOH or ED in case a mild-moderate exacerbation progresses and/or the reliever response is poor with the pMDI and spacer and in cases where patients present with more severe exacerbation cases. (76, 77)

Advantages of pMDI with a spacer vs wet nebuliser therapy

- This guideline recommends that Emergency Departments in Hospital and GPOOH and urgent care centres do not use nebulisers routinely for treatment of acute attacks, except where appropriate.
- Metered-dose inhalers (pMDI) with a spacer can perform at least as well as wet nebulisation in delivering β_2 agonists in acute asthma and the total dose of salbuterol given to patients is lower with MDI/spacer delivery.
- The MDI/spacer can also be cheaper and thus may be a more economical alternative to wet nebuliser delivery (51). The patient outcomes are similar and include the length of stay

in the emergency department for adults (although in children this was reduced). Peak flow and forced expiratory volume were also similar for the two delivery methods.

- The main advantage of using the pMDI with spacer approach is that it will reduce patient over-use of nebulisers in acute situations for less severe exacerbations. Often, patients focus on nebuliser therapy instead of standard inhaler with spacer and as these are generally not available at home this can encourage a reliance on hospital care, and lead to repeat hospital attendances by some patients for wet nebuliser although pMDI and spacer would be adequate.

Possible costs
The Volumatic® spacer or paper spacer requires less storage space and at similar cost. Many patients already use a spacer device but are unlikely to bring to an acute care setting. The cost of the Volumatic® spacer under the community drug scheme is €3.34 (Feb 2014). The Volumatic® pacer (single patient use) can be supplied to the patient on discharge from hospital (about 80% of patients). The annual potential costs of this approach is as follows: GPOOH attendances = 21,800 (€72,812) and ED attendances = 12,000 (€40,080). The annual possible savings, less use of nebulisers $8* x 27,040 (80%), converted from $ to € PPP, IRE, 2013 = 0.832.

Possible total costs: **€112,892**
Possible savings: $216,320 or **€179,978**
Possible savings: on non-attendances to ED and GPOOH

*Dhuperet al. reported equivalent efficacy of β_2 agonist delivery using a metered dose inhaler (MDI) with a spacer device compared to using a wet nebuliser in asthma patients. However, the median cost of treatment per patient was $10.11 (SD $10.03-$10.28) vs. $18.26 (SD $9.88-$22.45) in the spacer and nebuliser groups, respectively ($p < 0.001$). They concluded that there is no evidence of superiority of nebuliser to MDI/spacer β_2 agonist delivery for emergency management of acute asthma in this inner-city adult population. Thus the MDI/spacer may be a more economical alternative to wet nebuliser delivery in patients other than those with severe exacerbations.

B. Recommendations on medications e.g. inhaled steroids and oral steroids in acute asthma exacerbations.

- ***Stat dose of oral steroids in an acute exacerbation of asthma***

In ED or in-patient, patients may be given a stat dose of oral steroids (stat doses = few cents) and on discharge and leaving hospital (ED or in-patient), may be given a prescription for a full course of oral steroids (paid by patient or through medical card). [MIMS Ireland publication on GMS drug therapy, shows the cost of Deltacortril EC® i.e. oral steroids at €9.90/100 tablets, the stat doses is usually 6 tablets at €0.60 and 5 days x 6 tablets or €3.00 per course.

Possible total costs:
Stat doses - steroids €0.60 x 33,800 patients (ED and GPOOH) = €20,280
(The full course of 5 days of treatment at €3/course would be €101,400)

C. Recommendation of steroid inhaler therapy with short acting reliever inhaler

Inhaled steroid therapy
Fitzgerald and Gibson in the review article from 2006 on asthma exacerbation examined current knowledge of prevention in asthma exacerbations (78). They noted that the optimal strategies for the prevention of asthma exacerbations include the early introduction of anti-inflammatory treatment, most commonly this was low dose inhaled corticosteroids and recommended that this policy should be coupled with a structured education programme which has a written

action plan as an integral component. In addition Blais et al. (79) reported on a case-control study nested within a cohort of 13,563 newly treated subjects with asthma selected from the databases of Saskatchewan Health (1977–1993). This study was undertaken to investigate the effectiveness of a first treatment with inhaled corticosteroids in preventing admissions to hospital for asthma. Study subjects were aged between five and 44 years at cohort entry. First time users of inhaled corticosteroids were compared with first time users of theophylline for a maximum of 12 months of treatment. The conclusion from the study was that the first regular treatment with inhaled corticosteroids initiated in the year following the recognition of asthma reduced the risk of admission to hospital for asthma by up to 80% compared with regular treatment with theophylline. This is probably due, at least in part, to reducing the likelihood of a worsening in the severity of asthma.

On leaving hospital (ED or in-patient), inhaled steroid therapy should be prescribed as a preventer for all patients with an acute asthma exacerbation as well a short acting reliever inhaler for break through asthma symptoms. It is not envisaged that these inhaled medications would be supplied to the patient on leaving the ED so this may incur additional costs for patients without full medical cards on filling prescription but no costs to hospital and GPOOH as the patient is given a prescription but not the medications. Patients with medical cards will have access to this therapy without significant additional costs. However, even though prescribed, people with asthma do not always take their recommended treatment. This may be due to poor communication between healthcare professionals and those with asthma, lack of opportunity to discuss fear of side effects, omission of shared decision making, and the patient not feeling in control. Even if patients take their medication, many do not do so correctly i.e. poor inhaler technique, which will lead to suboptimal outcomes through poor asthma control which is costly leading to further exacerbations, GPOOH and ED attendances and hospital admissions. Therefore following discharge from ED patients should attend their GP for follow up of asthma and if admitted receive specialist follow up for 1 year at least in the medical out-patient service.

Possible costs: Undetermined (may include drug costs under GMS or DPS schemes)

D. Recommendation of follow up with GP within 2 working days of discharge from ED.

As part of the guidelines the patient will attend their GP for follow up of their asthma within 2 working days. There are potential costs with GP visits and it is recommended in the NCPA Model of Care that patients will enter the annual assessment or *Asthma Check* structured review which likely will attract increased costs at primary care level which are as yet undetermined. Central to the implementation process will be the standardisation of an asthma review. This will optimise treatment, ensure institution of inhaled corticosteroid therapy early in asthma management where appropriate, encourage medication adherence and address underlying problems with asthma care and management and include:

- Inhaler technique
- Adherence to and understanding of medications
- Self-management education including personal asthma plans management of co-morbidities and triggers including allergic rhinitis
- Smoking cessation and/or avoidance or exposure to second hand smoke.

Possible costs: Undetermined (but likely to attract increased costs for implementation of *Asthma Check* annual review of patients with asthma at primary care level).

E. Recommendations on follow up in the medical specialist/nurse led OPD clinic for 1 year for patients admitted to hospital with acute asthma following discharge.

About 20% or more of adult asthma patients may develop a repeat exacerbation requiring ED attendances and/or early re-admission to hospital within 1 month of discharge (73,74).

Involvement and follow up in an asthma nurse / respiratory specialist clinic has been shown to reduce re-hospitalisation rates to 0% with asthma nurse specialist input (75). If admitted to hospital for acute asthma it is recommend that patients be followed up in a specialist medical OPD for 1 year until stable. Occasionally patients may be followed in specialist medical OPD indefinitely if they have more severe or difficult to control asthma.

On average there will likely be 4 clinic visits per year (2 nurse led asthma clinic and 2 regular medical outpatient clinics, start and end of year).

Consultant/Medical OPD x 2 / year =
1,460 patients @ €130/clinic x 2 clinics = **€379,600**

Nurse specialist x 2 clinics / year (30 minutes per clinic, @ €42/hr.) and
1,460 patients @ €21/clinic (30 minutes) x 2 clinics = **€61,320**

Costs of service: **€440,920**

Potential savings:
The national asthma programme envisages that over 3 years of implementation that we expect a 30% reduction or more in asthma admission. The asthma nurse led clinic linked to the specialist asthma service would, based on international evidence (75) reduce the admission by 20% (avoidance of re-admission of patients attending this service commenced within the hospital prior to discharge and follow up within 1 month of discharge).

Potential savings: Asthma nurse-led clinic 20% reduction in admissions over 1-3 years
= 292 patients x €4,733.2* (admission cost/pt.) **= €1.38m**

*Coax study (20)

F. Recommendation that all patients have a peak flow meter reading on admission to GPOOH, ED and Hospital for ongoing assessment and management of acute asthma.

Since this usually forms part of standard medical equipment in hospital, this has not been included.

Cost: No extra costs envisaged with this

Table 8 Estimated costs and possible savings with Implementation of Acute Asthma Attack in Adults Guideline

Annual Estimated Cost for 1,460 acute asthma adult admissions x [€4733.2 per patient = cost in COAX study (20)]	€6.9m

Costs

Initial Set-up Costs	
The HSE cost for Asthma Society of Ireland SLA cost €29,084 per year from July 2011 – June 2015 (Total)	€116,336
Cost of attendance at training HSE staff	€193,104
Annual ongoing costs	
Possible costs spacer and pMDI	€112,892
Stat doses – steroids €0.60 x 33,800 patients (ED and GPOOH)	€20,280
Steroid inhaler therapy with short acting reliever inhaler	Costs: Undetermined
Follow visits with GP after ED discharge	Costs: Undetermined
Costs of specialist / nurse led asthma OPD visits for patients discharged after acute asthma admissions	€440,920
Peak flow meters at GPOOH and ED	No extra costs envisaged with this

Possible estimated annual savings

Possible savings: reduced nebuliser use in ED	€179,978
Better asthma management by specialist/asthma nurse led / specialist clinic following discharge leading to non-attendances at ED and GPOOH and reduced admissions by 20%	€1,380,000

Appendix 17.3. Economic search methodology

A systematic literature search was performed in October 2013 and in May 2014. The search strategy used the following PICOS.

Population: Adult Patients >16 years with acute exacerbation of asthma

Intervention: Economic effectiveness of interventions designed to manage acute exacerbations of asthma in adult patients >16 years

Comparison: Primary vs secondary care, otherwise no specific comparator

Outcome: Most cost effective interventions for managing acute exacerbations of asthma in adult patients > 16 years.

Inclusion and exclusion criteria
The inclusion criteria were as follows:

- Adult patients over the age of >16
- All studies considered however preference was given to the higher levels of evidence
  - Systematic Reviews
  - Meta-Analysis
  - Clinical Trials
  - Evaluation Studies
  - Expert Opinion
  - Editorials

Studies were excluded if they related to

- Children under the age of <16 years
- Patients suffering with milder forms of asthma
- Outside of the last five years

Children under the age of 16 were not excluded in the search terms for this work as a number of studies that mainly concentrated on adult asthma also contained some coverage of childhood asthma therefore to have specifically excluded any references to childhood asthma as a search term may also have excluded some potentially useful references to acute adult asthma.

Note: The search example included was from the PubMed database. The same search strategy was also employed on the other noted databases.

Databases Searched
The following databases were utilised in the literature search

- PubMed
- Embase
- Cochrane
- Web of Science
- NHS Evidence
- Google Scholar
- Up To Date
- Clinical Key
- One Search
- Database of Abstracts of Reviews and Effects (DARE)
- NHS Economic Evaluation Database
- Health Technology Assessment Database

Table 9 Search methodology

Search	Search Criteria	Hits
1	((acute asthma OR severe asthma OR persistent asthma OR asthma exacerbation)) AND "Asthma"[Mesh]	19047
2	((((((((((("Peak Expiratory Flow Rate"[Mesh] OR ("Inhalation Spacers"[Mesh]) OR "Nebulizers and Vaporizers"[Mesh] AND (("Oxygen"[Mesh]) OR ("Bronchodilator Agents"[Mesh] OR "Bronchodilator Agents"[Pharmacological Action])) OR ("Glucocorticoids"[Mesh] OR "Glucocorticoids"[Pharmacological Action])) AND "last 5 years"[PDat])) OR (((((("Ipratropium"[Mesh] OR "fenoterol, ipratropium drug combination"[Supplementary Concept] OR "albuterol-ipratropium"[Supplementary Concept]) OR ("Magnesium Sulfate"[Mesh] OR "dipyrithione"[Supplementary Concept])) OR ("Aminophylline"[Mesh] OR "aminophylline, cycloclenbutrerol, diphenydramine, phenobarbital drug combination"[Supplementary Concept])) OR ("Leukotriene Antagonists"[Mesh] OR "Leukotriene Antagonists"[Pharmacological Action])) AND "last 5 years"[PDat])) OR ((("Anti-Bacterial Agents"[Mesh] OR "Anti-Bacterial Agents"[Pharmacological Action]) OR "Infusions, Intravenous"[Mesh]) AND "last 5 years"[PDat])) OR (((((("heliox"[Supplementary Concept]) OR "Helium"[Mesh]) OR ("furosemide-albumin complex"[Supplementary Concept] OR "butoxymethylene furosemide"[Supplementary Concept] OR "furosemide glucuronide"[Supplementary Concept] OR "Furosemide"[Mesh])) OR "Noninvasive Ventilation"[Mesh]) Filters: published in the last 5 years	105277
3	((((((((((((((((((("Economics"[Mesh] OR "Economics, Medical"[Mesh] OR "Economics, Pharmaceutical"[Mesh]) OR "Costs and Cost Analysis"[Mesh]) OR "Health Care Costs"[Mesh]) OR "Decision Support Techniques"[Mesh]) OR "Models, Economic"[Mesh]) OR "Markov Chains"[Mesh]) OR "Monte Carlo Method"[Mesh]) OR "Uncertainty"[Mesh]) OR "Quality of Life"[Mesh]) OR "Quality-Adjusted Life Years"[Mesh])) OR ((economic impact OR economic value OR pharmaco-economics OR health care cost OR economic factors OR cost analysis OR economic analysis OR cost OR cost-effectiveness OR cost effectiveness OR costs OR health care cost OR cost savings OR cost-benefit analysis OR hospital costs OR medical costs OR quality-of-life)) OR ((econom$ OR cost OR costly OR costing OR costed OR price OR prices OR pricing OR priced OR discount OR discounts OR discounted OR discounting OR expenditure OR expenditures OR budget$ OR afford$ OR pharmcoeconomic OR pharmaco-economics$))) OR (econom$ OR cost OR costly OR costing OR costed OR price OR prices OR pricing OR primed OR discount OR discounts OR discounted OR discounting OR expenditure OR expenditures OR budget$ OR afford$ OR pharmacoeconomic OR pharmaco-economics$)) OR ((cost$[All Fields] OR adj1[All Fields]) OR (util$[All Fields] OR effective$[All Fields] OR efficac$[All Fields] OR benefit$[All Fields] OR consequence$[All Fields] OR analy$[All Fields] OR minimi$[All Fields] OR saving$[All Fields] OR breakdown[All Fields] OR lowering[All Fields] OR estimate$[All Fields] OR variable$[All Fields] OR allocation[All Fields] OR control[All Fields] OR illness[All Fields] OR sharing[All Fields] OR life[All Fields] OR lives[All Fields] OR affordable$[All Fields] OR instrument$[All Fields] OR technolog$[All Fields] OR day$[All Fields] OR fee[All Fields] OR fees[All Fields] OR charge[All Fields] OR charges[All Fields]) AND s[All Fields])) OR ((value OR values OR valuation) AND adj 2 AND (money OR monetary OR life OR lives OR costs OR cost))) OR ((qol OR qoly OR qolys OR hrqol OR qaly OR qalys OR qale OR qales))) OR ((sensitivity analys$ OR quality-adjusted life year$ OR quality adjusted life years$ OR quality-adjusted life expectanc$ OR quality adjusted life expectanc$))) OR (unit cost OR unit-cost OR unit-costs OR unit costs OR drug cost OR drug costs OR hospital costs OR health-care costs OR health care cost OR medical cost OR medical costs)))) Filters: published in the last 5 years	1461118
4	#1 AND #2 AND #3	761
5	primary care OR intensive care OR ICU OR hospital admission OR secondary care Filters: Systematic Reviews; Review; Randomized Controlled Trial; Practice Guideline; Meta-Analysis; Guideline; Evaluation Studies; Editorial; Controlled Clinical Trial; Clinical Trial; Case Reports; published in the last 5 years	49,909
6	#4 AND #5	54

Figure 2 below is a **Flow Diagram of retrieved studies** which is a short flow diagram detailing the numbers of articles retrieved and progress through the economic search.

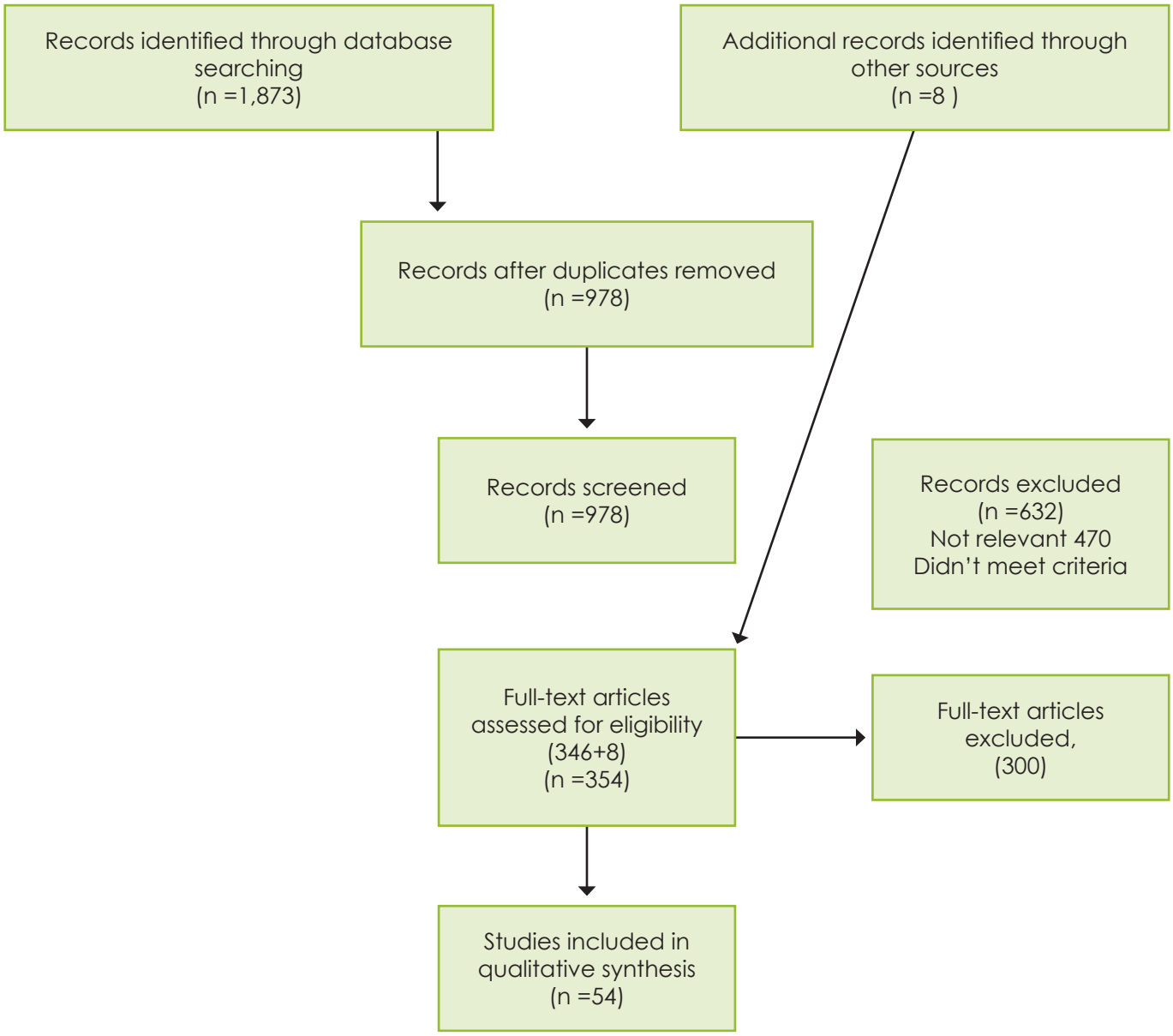


Figure 6 Flow Diagram of Retrieved Studies

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