

## Additional File: Appendices 1 - 8

### Appendix 1: Read codes for asthma, version 2

Code	Term
H33..	Asthma
H330.	Extrinsic (atopic) asthma
H3300	Extrinsic asthma without status asthmaticus
H3301	Extrinsic asthma with status asthmaticus
H330z	Extrinsic asthma NOS
H331.	Intrinsic asthma
H3310	Intrinsic asthma without status asthmaticus
H3311	Intrinsic asthma with status asthmaticus
H331z	Intrinsic asthma NOS
H332.	Mixed asthma
H333.	Acute exacerbation of asthma
H334.	Brittle asthma
H335.	Chronic asthma with fixed airflow obstruction
H33z.	Asthma unspecified
H33z0	Status asthmaticus NOS
H33z1	Asthma attack
H33z2	Late-onset asthma
H33zz	Asthma NOS
1780.	Aspirin induced asthma
1781.	Asthma trigger - pollen
1782.	Asthma trigger - tobacco smoke
1783.	Asthma trigger - warm air
1784.	Asthma trigger - emotion
1785.	Asthma trigger - damp
1786.	Asthma trigger - animals
1787.	Asthma trigger - seasonal
1788.	Asthma trigger - cold air
1789.	Asthma trigger - respiratory infection
178A.	Asthma trigger - airborne dust
178B.	Asthma trigger - exercise
102..	Asthma confirmed
66YK.	Asthma follow-up
663..	Asthma monitoring
663N.	Asthma disturbing sleep
663N0	Asthma causing night waking
663N1	Asthma disturbs sleep weekly
663N2	Asthma disturbs sleep frequently
663O.	Asthma not disturbing sleep
663O0	Asthma never disturbs sleep
663P.	Asthma limiting activities
663P0	Asthma limits activities 1 to 2 times per month
663P1	Asthma limits activities 1 to 2 times per week
663P2	Asthma limits activities most days
663Q.	Asthma not limiting activities

<b>Code</b>	<b>Term</b>
663U.	Asthma management plan given
663V.	Asthma severity
663V0	Occasional asthma
663V1	Mild asthma
663V2	Moderate asthma
663V3	Severe asthma
663W.	Asthma prophylactic medication used
663d.	Emergency asthma admission since last appointment
663e.	Asthma restricts exercise
663f.	Asthma never restricts exercise
663h.	Asthma - currently dormant
663j.	Asthma - currently active
663m.	Asthma accident and emergency attendance since last visit
663n.	Asthma treatment compliance satisfactory
663p.	Asthma treatment compliance unsatisfactory
663q.	Asthma daytime symptoms
663r.	Asthma causes night symptoms 1 to 2 times per month
663s.	Asthma never causes daytime symptoms
663t.	Asthma causes daytime symptoms 1 to 2 times per month
663u.	Asthma causes daytime symptoms 1 to 2 times per week
663v.	Asthma causes daytime symptoms most days
663w.	Asthma limits walking up hills or stairs
663x.	Asthma limits walking on the flat
663y.	Number of asthma exacerbations in past year
66YJ.	Asthma annual review
66YE.	Asthma monitoring due
66Y5.	Change in asthma management plan
66Y9.	Step up change in asthma management plan
66YA.	Step down change in asthma management plan
66Yq.	Asthma causes night time symptoms 1 to 2 times per week
66Yr.	Asthma causes symptoms most nights
66Yp.	Asthma review using Roy Colleg of Physicians three questions
8CMA0	Patient has a written asthma personal action plan
8B3j.	Asthma medication review
8793.	Asthma control step 0
8794.	Asthma control step 1
8795.	Asthma control step 2
8796.	Asthma control step 3
8797.	Asthma control step 4
8798.	Asthma control step 5
9OJ1.	Attends asthma monitoring
9OJA.	Asthma monitoring check done
173d.	Work aggravated asthma
663e0	Asthma sometimes restricts exercise
663e1	Asthma severely restricts exercise
66YC.	Absent from work or school due to asthma
66YK.	Asthma follow-up
66YP.	Asthma night-time symptoms

<b>Code</b>	<b>Term</b>
66YQ.	Asthma monitoring by nurse
66YR.	Asthma monitoring by doctor
66Ys.	Asthma never causes night symptoms
66Yu.	Number days absent from school due to asthma in past 6 month
8791.	Further asthma - drug prevent.
8CR0.	Asthma clinical management plan

## Appendix 2: List of asthma medications by BNF codes

Source: BNF March to September 2013; list of immuno-suppressants from AUK-PNG working group, the BNF codes of immuno-suppressants and the 'other conditions' they are used for are derived from Monthly Index of Medical Specialities (MIMS). Age criteria checked with BNF children.

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
Bronchodilators	Adrenoceptor agonists	Selective beta <sub>2</sub> agonists	03010101	Short acting beta <sub>2</sub> agonists	Salbutamol -Albuterol	Salbutamol - Non-proprietary, AirSalb, Salamol, Salamol Steri-Neb, Salapin,	tablet, injection (subcutaneous, intramuscular, intravenous), infusion (intravenous, inhalation of aerosol/powder/nebulised solution (inhalation)		✓	✓	RAO, premature labour	all age
						Ventmax SR	capsule		✓	✓		all age
						Ventolin	syrup, injection, accuhaler (dry powder for inhalation), respirator solution (for use with nebuliser or ventilator)		✓	✓		all age
						Airomir	aerosol inhalation		✓	✓		all age
						Asmasal Clickhaler	dry powder for inhalation		✓	✓		all age

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
						Easyhaler Salbutamol	dry powder for inhalation		✓	✓		all age
						Pulvinal Salbutamol	dry powder for inhalation		✓	✓		all age
						Salamol Esi-Breathe	aerosol inhalation		✓	✓		all age
						Salbulin Novolizer	dry powder for inhalation		✓	✓		all age
					Bambuterol hydrochloride	Bambec	tablet		✓	✓	RAO	
				Long acting beta2 agonists (LABA)	Formoterol (eformoterol) - Formoterol/eformoterol fumarate	Formoterol -Non-proprietary	dry powder for inhalation		✓	✓	RAO in patients	6 onwards 12 onwards 6 onwards 6 onwards
						Atimos modulite	aerosol inhalation		✓	✓		
						Foradil	dry powder for inhalation		✓	✓		
						Oxis Turbohaler	dry powder inhaler		✓	✓		
							Indaceterol - Onbrez		✓	✓		
					Salmeterol	Salmeterol - Non-proprietary, Neuvent, Xinofoate,	aerosol inhalation		✓	✓	RAO in patients	children
				Serevent - Accuhaler, Diskhaler, Evohaler		dry powder for inhalation (Accuhaler, Diskhaler), aerosol inhalation (Evohaler)		✓	✓			

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
					Terbutaline Sulfate	Bricanyl	tablet, syrup, injection (subcutaneous/slow intravenous, solution (continuous intravenous infusion))		✓	✓	RAO, premature labour	all age
				Bricanyl Turbohaler		powder for inhalation (Turbohaler)		✓	✓	all age		
				Bricanyl Respules		nebuliser solution		✓	✓	all age		
							Other adrenoceptor agonists 03010102- Adrenaline (epinephrine) - Adrenaline 1 in 1000, EpiPen, EpiPen Junior, Jext			✓	emergency treatment of acute allergic and anaphylactic reactions, angioedema, cardiopulmonary resuscitation, severe croup	

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria	
								Other adrenoceptor agonists 03010102- Ephedrine hydrochloride - Ephedrine hydrochloride - Non-proprietary		✓	RAO		
Bronchodilators	Antimuscarinic bronchodilators							Acridinium bromide -Eklira Genuair		✓			
		Ipratropium bromide	Ipratropium bromide - Non-proprietary	Atrovent	nebuliser solution	✓	✓	RAO, rhinitis	all age				
					aerosol inhalation	✓	✓		all age				
				Ipratropium Steri-Neb	nebuliser solution	✓	✓		all age				
				Respontin	nebuliser solution	✓	✓		all age				
							Tiotropium - Spiriva		✓				
Theophylline					Theophylline	Neulin SA	tablets		✓	✓	RAO	all age	
						Slo-Phyllin	capsules		✓	✓		2 onwards	

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria	
						Uniphyllin Continus	tablets		✓	✓		all age	
					Aminophylline	Aminophylline - Non-proprietary Phyllocontin Continus	injection tablets	✓ ✓	✓ ✓	RAO, bronchospas	all age		
	Compound bronchodilator preparations						Ipratropium bromide with Salbutamol - Non-proprietary, Salipraneb, Ipramol	nebuliser solution nebuliser solution		✓ ✓	✓ ✓		over 12 over 12
						Combivent			✓	✓			
	Peak flow meters, inhaler devices and nebulisers				Peak flow meters	Standard range peak flow meter	AirZone, Medi, MicroPeak, Mini-Wright, Personal Best, Piko-1, Pinnacle, Pocketpeak, Vitalograph			✓			over 5
						Low range peak flow meter	Medi, Mini-Wright, Pocketpeak		✓			over 5	



BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
				Inhaler devices	pressurised metered dose inhalers, breath-actuated inhalers and dry powder inhalers				✓	✓		in children, age not stated
				Spacer devices	AZA Spacer, Able Spacer, AeroChamber Plus, Babyhaler, Haleraid, Optichamber, Vortex Spacer, Pocket Chamber, Volumatic				✓	✓		in children, age not stated
				Nebulisers and compressors	Nebuliser diluent	Sodium chloride - Non-proprietary, Saline Steripoule, Saline Steri-Neb			✓	✓	RAO, cystic fibrosis, severe croup, pneumocystis pneumonia	in children, age not stated

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria	
Corticosteroids	Beclometasone dipropionate					Beclometasone - Non-proprietary, Pulvinal,	dry powder inhalation		✓	✓		in children, age not	
						Asmabec Clickhaler	dry powder inhalation		✓	✓		6 onwards	
						Becodisks	dry powder inhalation		✓	✓		5 onwards	
						Clenil modulite	aerosol inhalation		✓	✓		2 onwards	
						Qvar	aerosol inhalation		✓	✓		over 12	
						Compound						Fostair	aerosol inhalation
	Budesonide	Budesonide					Budesonide - Non-proprietary, Easyhaler Budesonide	dry powder inhalation		✓	✓		6 onwards
							Budelin Novolizer	dry powder inhalation		✓	✓		6 onwards
							Pulmicort Turbohaler	dry powder inhalation		✓	✓		5 onwards
	Cicle sonide						Symbicort, Symbicort 100/6 Turbohaler, Symbicort 200/6 Turbohaler, Symbicort 400/12 Turbohaler	dry powder inhalation		✓	✓		6 onwards
							Alvesco	aerosol inhalation		✓	✓		12 onwards
	Fluticasone propionate						Flixotide Accuhaler, Flixotide Evohaler, Nebules	dry powder for inhalation (Accuhaler), aerosol inhalation (Evohaler)		✓	✓		5 onwards

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
				Compound preparations		Flutiform Seretide, Seretide 100 Accuhaler, Seretide 250 Accuhaler, Seretide 500 Accuhaler, Seretide 125 Evohaler, Seretide 250 Evohaler	aerosol inhalation dry powder for inhalation (Accuhaler), aerosol inhalation (Evohaler)		✓	✓		12 onwards
						Asmanex Twisthaler			✓	✓		5 onwards
	Mometasone Furoate						dry powder inhalation		✓	✓		12 onwards
Cromoglicate and related therapy, leukotriene receptor antagonist	Cromoglicate and related therapy				Sodium cromoglicate/cromoglycate	Intal CFC-free Inhaler	aerosol inhalation		✓	✓	food allergy, allergic conjunctivitis, allergic rhinitis	5 onwards
					Nedocromil sodium	Tilade CFC-free Inhaler			✓	✓		5 onwards
	Leukotriene receptor antagonist				Montelukast	Singulair	tablets		✓		seasonal allergic rhinitis	All age

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	EXCLUDE	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
					Zafirlukast	Accolate	tablets		✓	✓		12-18 yrs
								Phosphodiesterase type-4 inhibitors -Roflumilast, Daxas				
								Antihistamines 030401, allergen immunotherapy 030402 <i>except</i> Omalizumab, allergic emergencies 030403				
						Xolair	injection		✓			over 6 years
					Omalizumab ONLY							

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	<i>EXCLUDE</i>	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
Immunosuppressants					Prednisolone	Predsol, Minims Prednisolone, Pred Forte, Deltacortil, Deltastab, Prednisolone, Prednisolone Soluble Tablets, Prednisolone Gastroresistant Tablets, Predsol Enema,	drops, tablets, injections		✓		ear conditions, eye inflammation, inflammatory and allergic disorders, croup, ulcerative colitis, Crohn's disease	all age
					Methotrexate	Maxtrex, Methotrexate, Metroject	tablet, injection		✓		antineoplastic s, rheumatoid arthritis, other autoimmune disorders, psoriasis, seborrhoea etc	

BNF section name	BNF sub-section name	BNF sub-sub-section name	BNF sub-sub-section number	BNF sub-sub-section name	BNF generic drug name	Drug brand name	Form	<i>EXCLUDE</i>	Asthma	COPD	Other conditions [reversible airways obstruction (RAO)]	Age criteria
					Ciclosporin	Capimune, Capsorin, Deximune, Neoral, Neoral capsules, Sandimmun	oral solutions, capsules		✓		rheumatoid arthritis, other auto-immune disorders, organ transplantation, psoriasis, seborrhoea etc, renal disorders, Inflammatory bowel disease	all age
					Azathioprine	Azathioprine, Imuran, Imuran injection	tablet, powder in vial		✓		rheumatoid arthritis, other auto-immune disorders, organ transplantation	all age

### Appendix 3: Read codes for asthma, version 3

Includes version 2 codes above and the following

Code	Term
XE0YX	Asthma NOS
Xa9zf	Acute asthma
XE0YW	Asthma attack
X1020	Pollen asthma
X1026	Baker's asthma
X102Y	Cardiac asthma
Ua1AX	Brittle asthma
XaIOV	Asthma finding
XaINi	Number of times bronchodilator used in one week
XaINj	Number of times bronchodilator used in 24 hours
Xalww	Asthma trigger
XaLIIm	Asthma trigger - respiratory infection
XaLIIn	Asthma trigger - seasonal
XaLIr	Asthma trigger - animals
XaLJS	Asthma trigger - cold air
XaLJT	Asthma trigger - damp
XaLJU	Asthma trigger - emotion
XaObi	Asthma trigger - airborne dust
XaObj	Asthma trigger - exercise
XaObk	Asthma trigger - pollen
XaObl	Asthma trigger - tobacco smoke
XaObm	Asthma trigger - warm air
XaYja	Asthma trigger - wind
XaYpF	Asthma trigger - perfume
X101x	Allergic asthma
XE2Nb	Asthma monitored
XaLPE	Nocturnal asthma
X101t	Childhood asthma
Xaler	Asthma follow-up
XalnC	Suspected asthma
XaluG	Asthma confirmed
X1027	Colophony asthma
XM1Xb	Asthma monitoring
X101u	Late onset asthma
XM0s2	Asthma attack NOS
X1025	Industrial asthma
X102D	Status asthmaticus
XE0YV	Status asthmaticus NOS
XE0YT	Non-allergic asthma
X1025	Occupational asthma
X102D	Acute severe asthma
X101z	Allergic asthma NEC
X1023	Drug-induced asthma
XaQHq	Asthma control test

<b>Code</b>	<b>Term</b>
Xa0IZ	Asthmatic bronchitis
Xa8Hn	Asthma control steps
Xaleq	Asthma annual review
XaLJT	Asthma trigger - damp
XaYja	Asthma trigger - wind
XaIRN	Asthma monitoring due
X1020	Hay fever with asthma
X1028	Grain worker's asthma
XE0YQ	Allergic atopic asthma
XaJFG	Aspirin-induced asthma
Xa1hD	Exacerbation of asthma
XE0YV	Status asthmaticus NOS
XaBU2	Asthma monitoring call
XaKdk	Work aggravated asthma
X1029	Sulphite-induced asthma
XaIIZ	Asthma daytime symptoms
XaObk	Asthma trigger - pollen
XaLJU	Asthma trigger - emotion
XaYpF	Asthma trigger - perfume
XaBU3	Asthma monitoring status
XE2Na	Asthma monitoring admin.
XaBAQ	Recent asthma management
XalfK	Asthma medication review
XaDvK	Asthma - currently active
XaJtu	Referral to asthma clinic
X1021	Allergic non-atopic asthma
XaloE	Asthma night-time symptoms
Xalu5	Asthma monitoring by nurse
XaDvL	Asthma - currently dormant
Xalu6	Asthma monitoring by doctor
XaQig	Asthma control questionnaire
XaJ2A	Did not attend asthma clinic
XE2Nb	Asthma monitoring check done
XaR8K	Did not attend asthma review
XM1U3	Asthma clinic administration
XaY2q	Seen in school asthma clinic
Xa1hD	Acute exacerbation of asthma
XaIQ4	Change in asthma management plan
X102G	Asthmatic pulmonary eosinophilia
XaINg	Asthma limits walking on the flat
XaXZp	Asthma causes symptoms most nights
XaY2V	Asthma never causes night symptoms
XaXZx	Asthma limits activities most days
XaYb8	Asthma self-management plan agreed
XaYZB	Asthma self-management plan review
XaQig	ACQ - Asthma control questionnaire
XaJ2A	DNA - Did not attend asthma clinic
X1022	Intrinsic asthma with asthma attack



<b>Code</b>	<b>Term</b>
X101y	Extrinsic asthma with asthma attack
XaINa	Asthma never causes daytime symptoms
X1024	ASA - Aspirin-sensitive asthma triad
XaJuw	Does not have asthma management plan
XaQij	Under care of asthma specialist nurse
XaLIIm	Asthma trigger - respiratory infection
Xaa7Q	No asthma trigger identified by subject
XaIIIX	Asthma treatment compliance satisfactory
XEOYS	Extrinsic asthma with status asthmaticus
XaIQD	Step up change in asthma management plan
XaINd	Asthma causes daytime symptoms most days
XEOYU	Intrinsic asthma with status asthmaticus
XaIR3	Absent from work or school due to asthma
XaINf	Asthma limits walking up hills or stairs
XaRFj	Health education - asthma self-management
XaQih	Mini asthma quality of life questionnaire
XaIQE	Step down change in asthma management plan
XaIIY	Asthma treatment compliance unsatisfactory
X1024	Aspirin-sensitive asthma with nasal polyps
XEOYR	Extrinsic asthma without status asthmaticus
XaINh	Number of asthma exacerbations in past year
Xaa7B	Chronic asthma with fixed airflow obstruction
Xa544	Accidental poisoning by herbal asthma mixture
XaNKw	Royal College of Physicians asthma assessment
XaJ4W	Exception reporting: asthma quality indicators
XaXZu	Asthma limits activities 1 to 2 times per week
XaRFk	Health education - structured asthma discussion
XaXZs	Asthma limits activities 1 to 2 times per month
XaRFi	Patient has a written asthma personal action plan
XaINZ	Asthma causes night symptoms 1 to 2 times per month
XaINc	Asthma causes daytime symptoms 1 to 2 times per week
XaINb	Asthma causes daytime symptoms 1 to 2 times per month
XaXZm	Asthma causes night time symptoms 1 to 2 times per week
XaIIW	Asthma accident and emergency attendance since last visit
Xa546	Poisoning by herbal asthma mixture of undetermined intent
XaJ50	Excepted from asthma quality indicators: Informed dissent
XaXa0	Royal College of Physicians asthma assessment three questions score
XaJ4z	Excepted from asthma quality indicators: Patient unsuitable
XaX3n	Asthma review using Royal College of Physicians three questions
XaYZh	Number of days absent from school due to asthma in past 6 months
XaRFI	Health education - structured patient focused asthma discussion

## Appendix 4: Price weights and costings methodology

Variable	Value			Notes/source
GP consultations	£40	per	consultation	Personal Social Services Research Unit (PSSRU)[1]
Practice nurse consultation	£14	per	consultation	Personal Social Services Research Unit (PSSRU)[1]
Out-of-hour calls	£28.38	per	call	£25.53 in 2007/8,[2] inflated to 2011/12 using HSCS index[1]
Community prescribing:	Micro-costed	per	Prescription	
	<i>Scotland</i>	Costing at prescription level (Gross Ingredient Costs including discount for broken bulk) based on pre-calculated internal price weights.		Prescribing Information Systems data internal price estimates.
	<i>Wales</i>	Costing at prescription level based on Net Ingredient Costs from British National Formulary.		British National Formulary 2012[3]
Ambulance trips	£294	per	journey	£257 in 2006/7,[4] inflated to 2011/12 using HSCS index[1]
A&E visit	£108	per	visit	Department of Health (DoH), NHS reference costs[4]
Inpatient episodes:	Micro-costed	per	Episode	
	<i>England, Northern Ireland and Scotland</i>	Costing at episode level based on admission type (day case, elective, non-elective short, non-elective long) and HRG4 code		Department of Health (DoH), NHS reference costs[4]
	<i>Wales</i>	Costing per episode based on admission type (day case, elective, non-elective short, non-elective long).		Source: English per episode cost estimates derived as above.
ICU episodes: Children	Average cost per day (Males: £2,299.23, Females: £2,304.86) multiplied by length of stay based on HRG4 code based costing of subsample of episodes			Department of Health (DoH), NHS reference costs[4]
ICU episodes: Adults	£2,324.46 per episode			Weighted average cost of a critical care stay for 0 or 1 organ supported[4]
Disability Living Allowance:				
	<i>England, Scotland and Wales</i>	Aggregated level costs provided only, these have been derived from absolute values of public records of benefit payment records		Department of work and pensions
	<i>Northern Ireland</i>	Aggregated level costs provided only, these have been derived from absolute values of public records of benefit payment record		Department for Social Development

**Appendix 5 Data sources and mapping used in economic modelling of the cost of asthma in the UK by member countries**

Variable	Countries			
	England	Northern Ireland	Scotland	Wales
<b>Annual prevalence of GP-reported-diagnosed-and-treated asthma absolute values</b>	Quality of Outcomes Framework	Quality of Outcomes Framework	Quality of Outcomes Framework	Quality of Outcomes Framework
<b>Population distributions by age and sex groupings in people aged 40 years and less</b>	Health Survey for England 2010	Proportions assumed to be equal to those from Health Survey for England 2010	Scottish Health Survey 2010	SAIL GP database 2010/11
<b>Population distributions by age and sex groupings in people above 40 years</b>	Health Survey for England 2010	Health Survey for Northern Ireland 2010	Scottish Health Survey 2010	SAIL GP database 2010/11
<b>GP consultations</b>	Mapped from Scotland	Mapped from Scotland	Practice Team Information	Mapped from Scotland
<b>Practice Nurse consultations</b>	Mapped from Scotland	Mapped from Scotland	Practice Team Information	Mapped from Scotland
<b>Community prescribing in people aged 40 years and less</b>	Mapped from Wales	Mapped from Wales	Prescribing Information System	SAIL GP database 2010/11
<b>Community prescribing in people aged over 40 years</b>	Mapped from Wales	Mapped from Wales	Mapped from Wales	SAIL GP database 2010/11
<b>Calls to out-of-hours</b>	Mapped from Scotland	(Not applicable)	NHS 24	Mapped from Scotland
<b>Ambulance trips</b>	Mapped from Scotland	Mapped from Scotland	Scottish Ambulance Service	Mapped from Scotland
<b>A&amp;E</b>	Mapped from Scotland	Extract of data from Belfast HSCT	A&E Datamart	Mapped from Scotland
<b>Hospital episodes</b>	Hospital Episode Statistics	Department of Health, Social Services and Public Safety Northern Ireland	Scottish Morbidity Records for inpatient and day-cases	Patient Episode Data for Wales
<b>ICU episodes in children</b>	Paediatric Intensive Care Audit Network	Paediatric Intensive Care Audit Network	Paediatric Intensive Care Audit Network	Paediatric Intensive Care Audit Network
<b>ICU episodes in adults</b>	Intensive Care National Audit and Research Centre	Intensive Care National Audit and Research Centre	Scottish Intensive Care Society Audit Group	Intensive Care National Audit and Research Centre
<b>Disability living allowance</b>	Department of Work and Pensions	Department for Social Development in Northern Ireland	Department of Work and Pensions	Department of Work and Pensions

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## **Appendix 6: Cost modelling technical supplement**

### **Health and societal care costs of asthma**

Healthcare costs were estimated from an NHS perspective based on healthcare utilisation. Supplement 1 summarises the costing methodology applied to each resource type and the associated variables. Where possible cost estimates of the resource being measured were taken from any cost estimates inherent in its dataset. However for the majority of cases, standard UK price weights were applied. All costs were estimated from a base year of 2011/12 applying appropriate inflation indices where required.

### **Mapping of resource use from one country to another**

Where data on a particular form of resource use was available in one member country but not in another, the cost associated with the resource in the country for which data was unavailable was estimated by mapping the total costs associated with the resource in the country for which data was available. Table 1 shows the data sources used for each resource type in each country.

This mapping was undertaken adjusting for the age and sex distributions of the population as a whole, based on the population estimates, and the prevalence of asthma in that country (also adjusting for age and sex distributions). The only comparable prevalence figures available in all four of the UK member countries to make this adjustment are those from QoF. However the QoF figures are unable to provide prevalence estimates broken down by age and sex due to the way the data are collected. In order to allow the mapping process to take into account any differences in the distributions of asthma sufferers in each country, the total number of asthma sufferers in each country were broken down into age and sex groupings based on the proportion of asthma sufferers reported in the health surveys for each country, except Wales where these were based on the SAIL GP data for current treated asthma due to the considerably larger sample size that was available.

When extrapolating a particular form of cost estimate of from one country to another, the cost estimates for a given age-sex grouping per head of population were first extrapolated to population level estimates within their host country, if they did not already represent a complete sample. These were then divided by the respective age-sex group of the adjusted annual prevalence of GP-reported-diagnosed-and-treated (QoF) estimates of asthma sufferers in the home country and multiplied by the equivalent in the country being mapped to. This approach effectively rescales on each country's absolute population size, relative (as opposed to absolute) annual prevalence of GP-reported-diagnosed-and-treated (QoF) prevalence and the age and sex distributions of each within each country. However it is unable to account for differences between countries in terms of a number of other likely important factors, in particular the profile of the severity of disease, socioeconomic profiles of the population, environmental factors, care pathways or availability or quality of healthcare facilities.

Unfortunately the data available did not facilitate adjustment for these factors and they remain a limitation of both the study and the available data stock on asthma, though some of these elements could potentially be

overcome if access to some of the larger GP databases (which were unfortunately beyond the budget of this project) were to be utilised. Further work is being undertaken to investigate methodological approaches which might overcome some of these issues in the future as part of the UK Asthma Observatory.

### **Economic modelling**

An economic model of the cost of asthma in the UK and its member countries was built in Microsoft Excel 2010. This was used to:

- i. Apply the mapping techniques and synthesis of data with wider literature and price weights,
- ii. Sum up the cost estimates into the required groupings (e.g. NHS costs, wider societal costs each by age and gender groupings described above), and estimate 95% CI around the joint distributions of each total cost estimate. In order to estimate CI around the cost totals, the model applied probability distributions based on the observed averages and appropriate measures of uncertainty (such as standard errors or standard deviations) for parameters of interest. The 95% CI was estimated by taking bootstrapped samples from the distributions applied to each parameter simultaneously and running the model based on this set of sampled parameter estimates thus capturing their joint distribution within the bootstrapped sample. 10,000 bootstrapped replicated were used. The required 95% CI was then estimated using the percentile method based on these samples.[5]

It is important to be aware when using these confidence intervals that such an approach does not account for methodological uncertainty for example the assumption that rates of utilisation in the country being mapped from are equal to the rates of utilisation of the same resource in the country being mapped too. These confidence intervals only capture the uncertainty around the individual parameters going into the bootstrapping process, such as the interval around the prevalence estimate and the rate of utilisation. Hence the confidence intervals provided are subject to the same assumptions of the data they are derived from. More sophisticated approaches which may allow formal integration of such uncertainty are being investigated for future work in this area as part of the UK Asthma Observatory.

## Appendix 7: Comparison of mapped inpatient episodes to known values for their respective countries

Result Country	Base Case (£000's)	Country mapped from			
		England (£000's)	Northern Ireland (£000's)	Scotland (£000's)	Wales (£000's)
<b>England</b>	69,162	69,162	65,636	70,730	122,373
<b>Northern Ireland</b>	2,064	2,312	2,064	2,278	4,158
<b>Scotland</b>	6,342	6,708	6,178	6,342	12,381
<b>Wales</b>	8,128	5,255	5,018	5,501	8,128
<b>UK</b>	<b>85,696</b>	<b>83,437</b>	<b>78,895</b>	<b>84,851</b>	<b>147,040</b>

Bold text indicates base case result as used in the model

## Appendix 8: Data publicly available online

- 1) Quality and Outcomes Framework (QOF), obtainable for
  - England from <http://www.hscic.gov.uk/qof>,
  - Scotland from <http://www.isdscotland.org/Health-Topics/General-Practice/Quality-And-Outcomes-Framework/>,
  - Wales from <http://gov.wales/statistics-and-research/general-medical-services-contract/?tab=previous&lang=en>,
  - Northern Ireland from <https://www.health-ni.gov.uk/publications/quality-and-outcomes-framework-qof-achievement-data-201112>
- 2) national health surveys, obtainable for
  - England from <https://discover.ukdataservice.ac.uk/catalogue/?sn=6986>,
  - Scotland from <https://discover.ukdataservice.ac.uk/catalogue/?sn=6987>,
  - Wales from <http://gov.wales/statistics-and-research/welsh-health-survey/?tab=previous&lang=en>,
  - Northern Ireland from <https://www.health-ni.gov.uk/articles/health-survey-northern-ireland>

## References

1. Curtis L, Personal Social Services Research Unit (PSSRU) University of Kent. Unit Costs of Health and Social Care 2012. 2012 <http://www.pssru.ac.uk/project-pages/unit-costs/2012/> Accessed: 7 March 2016.
2. UK Parliament Commons Debates -Daily Hansard - Written Answers. NHS Direct: Operating Costs. 21 Oct 2008 : Column 314W 2008 [http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm081021/text/81021w0033.htm#column\\_314W](http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm081021/text/81021w0033.htm#column_314W) Accessed: 8 March 2016.
3. British National Formulary (BNF). 2012 [www.bnf.org](http://www.bnf.org) Accessed: 3 March 2016.
4. Department of Health (DoH). NHS reference costs 2011-12 <https://www.gov.uk/government/publications/nhs-reference-costs-financial-year-2011-to-2012> Accessed: 3 March 2016.
5. Briggs AH, Wonderling DE, Mooney CZ: Pulling cost-effectiveness analysis up by its bootstraps: a non-parametric approach to confidence interval estimation. *Health Econ* 1997, 6:327-340.