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Association of childhood attention-deficit/hyperactivity disorder with atopic diseases and skin infections? A matched case-control study using the General Practice Research Database

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ABSTRACT

Background: Data to support the hypothesis of a relationship between attention-deficit/hyperactivity disorder (ADHD) and allergies are conflicting.

Objective: To assess whether children with ADHD are more likely to have a history of atopic disorders, skin infections, and medical prescriptions than children without ADHD.

Methods: We conducted a nested case-control study among boys using the UK General Practice Research Database (GPRD). Cases were defined as children with first-time diagnosis of ADHD who were treated with methylphenidate. Four controls who had neither ADHD nor ADHD drug prescriptions in their medical records were matched to each case on age and general practice.

Results: We identified 884 boys with a first-time diagnosis of drug-treated ADHD and 3,536 controls. The independent odds ratios adjusted for age and presence of low birth weight or preterm delivery were 1.4 (95% confidence interval [CI], 1.2–1.7; $P < .001$) for a medical history of asthma, 1.5 (95% CI, 1.3–1.9; $P < .001$) for impetigo, and 1.5 (95% CI, 1.3–1.7; $P < .001$) for any antihistamine drug prescriptions. Other exposures that were more common in cases than controls, though not independently, were cow's milk intolerance and any prescription from the drug categories antiasthmatics, respiratory corticosteroids, topical steroids, antibacterials, or antifungals.

Conclusion: Despite possible limitations inherent to observational studies, this study lends support to the emerging evidence that childhood ADHD is associated with atopic diseases and impetigo. Further interdisciplinary research is needed to understand the underlying mechanisms and to evaluate targeted preventive, diagnostic, and therapeutic interventions.

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Introduction

Attention-deficit disorder or attention-deficit/hyperactivity disorder (ADHD) is a chronic mental health disorder of children and young adults, most commonly males, characterized by lack of attention, hyperactivity, and impulsivity.¹ Its consequences can be severe and may lead to disruptive and antisocial behavior, substance abuse, and a variety of problems relating to academic performance. ADHD is associated with many other mental health disorders, in particular anxiety and mood disorders, and increased health care consumption.^{1–3} In the United Kingdom and the United

States it has been estimated that up to 9% of all children now have a diagnosis of ADHD, and in the United States alone, nearly 60% are reported to be taking a prescription medication.^{1,4} A systematic review of 13 US studies estimated the annual costs of ADHD to range from \$12,005 to \$17,458 per patient (in 2005 US dollars), and annual societal costs of ADHD for the United States alone are estimated to be more than \$40 billion.⁵

The increase in prevalence of diagnoses of ADHD during the past decades was paralleled by a worldwide increase in atopic diseases and allergy-related skin infections, such as impetigo, with large variations among countries.^{6–10} Environmental risk factors that provoke allergic reactions, such as certain food allergens, have been implicated in increasing symptoms of both ADHD and allergic asthma.^{8,11–13} This finding suggests that in addition to a possible strong genetic component increased exposure to environmental factors may contribute to the development of these disease entities,

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but possible shared etiologic pathways are still not well understood.^{6,9,11,14,15} Feingold¹⁶ in 1975 postulated the hypothesis that certain food components induce hyperactivity among children. Exposure to foods and inhalants and subsequent type 1, immediate (IgE-mediated), hypersensitive mechanisms may play an important role in the causation of ADHD, which could have significant implications for prevention, diagnosis, and treatment.^{11,15} Epidemiologic data to support this hypothesis are, however, scarce, conflicting, and methodologically constrained.^{14,17} The widely used UK General Practice Research Database (GPRD) covering more than 7 million patients provided us the unique opportunity to assess the associations between childhood ADHD and atopic disorders (eg, asthma), skin infections, and medical prescriptions for these disorders.

Methods

Design, Setting, and Participants

This nested, matched case-control study was conducted using data from the UK GPRD, which is administered by the Medicines and Healthcare Products Regulatory Agency and has been previously described in detail.^{18–20} In brief, the GPRD contains electronic medical records for a nationally representative group of British residents currently enrolled in more than 450 general practice offices in the United Kingdom. General practitioners who participate in the GPRD have agreed to provide patient data for research purposes and are trained to accurately record information about patient demographics, medical diagnoses, and procedures that are part of routine care or resulting from hospitalizations, results of laboratory and pathology testing, and referrals to hospitals and specialists. In addition, the GPRD includes detailed information about prescriptions and vaccinations, including dates, formulation, strength, quantity, and dosing instructions. Importantly, most prescriptions that are initially prescribed by specialists, such as methylphenidate or atomoxetine in childhood, continue to be prescribed by general practitioners and hence are recorded in the database. The quality and completeness of the information recorded in the GPRD have been widely validated.^{18–20} Ethical approval for observational studies with anonymized data from the UK GPRD is waived. This study was approved by the Independent Scientific Advisory Committee within the UK Medicines and Healthcare Products Regulatory Agency.

Definition of Cases and Controls

The source population of the study was restricted to male patients because most childhood ADHD occurs in males.^{6,21} Cases were defined as boys with drug-treated ADHD diagnosed in the study years from 1996 to 2006. In accordance with a previous study,²¹ incident cases of ADHD within the study population were defined as all boys younger than 15 years who were recorded as having a first-time diagnosis of ADHD (read codes for this disease: E2E0.00, child attention deficit disorder; E2E0100, attention deficit with hyperactivity; or E2E..00, childhood hyperkinetic syndrome). To be eligible for the study, each case of ADHD was required to have at least one recorded prescription of methylphenidate, the most commonly prescribed ADHD drug in the United Kingdom,^{1,21} within 12 months after the date of their first diagnosis. For the nested case-control study, each incident methylphenidate-treated ADHD case was matched to 4 controls on age at index date (± 1 year) and general practice. Controls were selected from the source population of male patients with no diagnosis of ADHD or treatment with either methylphenidate or atomoxetine, an infrequently prescribed ADHD drug. For the case-control analysis, it was required that cases and controls had medical records starting at least 3 years before the index date to have adequate medical histories.

Definition of Atopic Diseases, Skin Infections, and Drug Treatments

For each case and control, we identified diagnoses of atopic disorders, including asthma (for read codes see the [eAppendix](#)), atopic dermatitis (M111.00), allergic rhinitis (all H17 codes), and unspecific allergies (SN53.00), food allergy (SN58.00, with or without cow's milk intolerance), or cow's milk intolerance (C313.11, with or without food allergy) recorded in the medical histories before the index date. Asthma diagnoses included allergic asthma, such as hay fever, pollen, wood, or detergent asthma, and exercise-induced asthma or unspecified asthma. We further recorded the presence of the skin infection impetigo (all M05 codes), which has been associated with atopic dermatitis.^{22,23} Finally, we recorded the presence of any antihistamine prescriptions, topical corticosteroids, topical antibacterials or topical antifungals, and anti-asthmatics (see the [eAppendix](#) for a list of drugs). In addition to the matching factors, we obtained information on the presence of low birth weight or preterm delivery as potential confounders that have been associated with asthma and ADHD (see the [eAppendix](#) for the read codes).^{14,24,25} We did not exclude cases or controls who had other comorbidities or comedication, but analyzed the prevalence of autism (read code RE140.12) in the cases because of potential modification of effects.

Statistical Analysis

In the case-control analysis, we first conducted descriptive analyses to assess the frequency of covariates within cases and controls. We applied conditional logistic regression analyses to explore the association between each covariate, controlling for confounding factors, and the diagnosis of childhood ADHD. A multivariable conditional logistic regression model was subsequently developed to obtain the independent associations of the covariates that statistically significantly contributed to the model using backward and forward modeling procedures. Odds ratios (ORs) with 95% confidence intervals (CIs) are presented as measures of relative risk. We further explored whether the age at index date modified the associations by examining the associations in young vs older individuals, taking the mean age as the cutoff. Finally, we examined the potential for selection bias because of differential contact with medical care by restricting the analyses to those boys who had a medical history of conjunctivitis (read code all F4C categories), a common disease in children who may have an allergic component. Because the retrieved read or prescription drugs were either absent or present in the database, we did not have missing data. The statistical analyses were performed using the SAS statistical software program, version 9.1 (SAS Institute Inc, Cary, North Carolina).

Results

We reviewed 1,880,975 records of boys younger than 15 years during the study period of 1996 to 2006 and found a total of 3,388 boys with an incident diagnosis of ADHD. Of these boys, 1,864 (55%) were treated with methylphenidate. We identified 884 boys with a first-time record of drug-treated ADHD who could be matched to 3,536 boys without ADHD who met all study criteria. The age at which a first diagnosis of ADHD was made ranged from 4 to 14 years, although most cases were in the age range of 7 to 9 years (38%) and 10 to 14 years (49%). The mean (SD) age of cases and controls was 9.6 (2.6) years. Low birth weight and preterm birth were more common in cases (3.5%) than in controls (1.5%). Autism was present in only 4 ADHD cases.

At least one atopic disorder, most commonly asthma (24.6%), was present in approximately one-fourth of controls ([Table 1](#)). As expected, drugs to treat these conditions were also common among controls; 47.5% received at least one antiasthmatic drug prescription, 36.6% received an antihistamine prescription, and 34.1% received

Table 1

Associations of characteristics of boys 4 to 14 years old with a first-time diagnosis of attention-deficit/hyperactivity disorder compared with age- and practice-matched controls

Characteristic	Cases (n = 884)	Controls (n = 3536)	OR (95% CI)	P value ^a
Atopic disorders				
Asthma	302 (34.2)	871 (24.6)	1.6 (1.3–1.9)	<.001
Allergic rhinitis	96 (10.9)	358 (10.1)	1.1 (0.9–1.4)	.49
Atopic dermatitis	72 (8.1)	237 (6.7)	1.3 (0.9–1.7)	.10
Any atopic disorder	392 (44.3)	1196 (33.8)	1.6 (1.3–1.8)	<.001
Allergy disorders				
Unspecific allergies	107 (12.1)	411 (11.6)	1.5 (0.8–1.3)	.67
Food allergy	7 (0.8)	19 (0.5)	1.6 (0.7–3.9)	.30
Cow's milk intolerance	13 (1.5)	24 (0.7)	2.1 (1.1–4.1)	.03
Impetigo	185 (20.9)	513 (14.5)	1.6 (1.3–1.9)	<.001
Drug prescriptions				
Any antiasthmatic drug	496 (56.1)	1681 (47.5)	1.4 (1.2–1.6)	<.001
Any respiratory corticosteroids	255 (28.9)	788 (22.3)	1.4 (1.2–1.7)	<.001
Any antihistamines	415 (47.0)	1294 (36.6)	1.6 (1.4–1.9)	<.001
Any topical steroids	337 (38.1)	1206 (34.1)	1.2 (1.0–1.4)	.02
Any topical antifungals	175 (19.8)	584 (16.5)	1.3 (1.0–1.5)	.02
Any topical antibacterials	198 (22.4)	692 (19.6)	1.2 (1.0–1.5)	.04

Abbreviations: CI, confidence interval; OR, odds ratio.

^aAdjusted for age at index date and low birth and/or preterm delivery.

a topical steroid prescription. Cases had a higher frequency of history of at least one atopic disorder than controls (44.3% vs 33.8%; 95% CI 1.3–1.8, OR, 1.6; $P < .001$). After adjustments for age and a history of low birth weight and/or preterm birth, a history of asthma, cow's milk intolerance, impetigo, and any prescription from the drug categories of antiasthmatics, respiratory corticosteroids, antihistamines, topical steroids, antibacterials, or antifungals were all associated with ADHD. A history of atopic dermatitis was almost statistically significantly associated with ADHD, and food allergies and nonspecific allergies were more common in ADHD cases than controls, although this finding was not statistically significant.

In multivariable analysis, the following factors were all independently and statistically significantly associated with ADHD: a history of asthma, impetigo, and any prescriptions of antihistamines (Table 2). Stratified analyses according to age at index revealed no materially different results for younger compared with older diagnosed patients. However, the associations were attenuated in the younger group compared with the older group in analyses where the exposure was any atopic disorder (younger: OR, 1.8; 95% CI, 1.4–2.2; vs older: OR, 1.4; 95% CI, 1.1–1.8). Also, in analyses restricted to boys with a medical history of conjunctivitis ($n = 1,753$), the association of asthma, impetigo, and antihistamines with ADHD did not materially change (OR, 1.3, 1.5, and 1.5, respectively; all $P < .02$).

Table 2

Multivariable conditional logistic regression model of the association of first-time attention-deficit/hyperactivity disorder among boys 4 to 14 years old

Characteristic	OR (95% CI) ^a	P value
All study participants ($n = 4,420$)		
Asthma	1.4 (1.2–1.7)	<.001
Impetigo	1.5 (1.3–1.9)	<.001
Any antihistamine prescription	1.5 (1.3–1.7)	<.001
Young (<9.6 years, $n = 2,220$)		
Asthma	1.6 (1.3–2.1)	<.001
Impetigo	1.6 (1.2–2.1)	<.001
Any antihistamine prescription	1.5 (1.2–1.9)	<.001
Older (≥ 9.6 years, $n = 2,200$)		
Asthma	1.3 (1.0–1.6)	.06
Impetigo	1.5 (1.1–2.0)	.009
Any antihistamine prescription	1.5 (1.3–1.9)	<.001

Abbreviations: CI, confidence interval; OR, odds ratio.

^aAdjusted for age at index and low birth weight and/or preterm birth.

Discussion

The results of this study of atopic risk factors for ADHD in the UK GPRD suggest that there is an increased risk of ADHD in boys with a history of asthma or impetigo and an even stronger risk associated with cow's milk intolerance. These associations were not materially modified by age at first diagnosis. Asthma and impetigo were both common exposures in children with ADHD, whereas cow's milk intolerance was not. Prescription drugs to treat these conditions were also associated with increased risks of ADHD.

These results support the hypothesis that exposure to foods and inhalants and subsequent type I, immediate (IgE-mediated), hypersensitive mechanisms could play an important role in the causation of ADHD. Histaminergic systems have been implicated in atopic diseases, and proinflammatory mechanisms have also been implicated in the development of ADHD.¹¹ Findings from Pelsser et al¹¹ further support the hypothesis that ADHD may be a hypersensitivity disorder similar to allergy in some children and that allergic and nonallergic forms of ADHD may be distinguished.^{16,17} They recently demonstrated that a strictly supervised restricted elimination diet improved ADHD symptoms in 64% of children with ADHD and after challenge relapse occurred in 63% of them independent of IgG blood levels.¹⁵

Mogensen and colleagues¹⁴ found that 68% of the phenotypic correlation between asthma and hyperactivity-impulsivity was due to genetic influences; thus, a strong genetic component may also explain the associations found in this study. Although the risk factors assessed in this study preceded the occurrence of ADHD and the associations were independent of measured confounders, the relationships may not be causal. They may rather be due to a shared pathophysiologic mechanism that may have a strong genetic and environmental component.¹⁵

The results of our study regarding asthma are also consistent with many previous studies, including the mentioned study conducted by Mogensen et al,¹⁴ who observed an even higher positive association between early asthma and later ADHD diagnosis in a population-based prospective twin study in Sweden. However, in that study both the asthma exposure and the ADHD symptoms were parent reported, which may have led to recall bias and overestimation of the effect estimate. Moreover, it is possible that selection bias due to nonresponse may have occurred. Our results are also in agreement with a recent study by Fasmer et al,²⁶ who found a stronger positive association between self-reported asthma prevalence and ADHD among 594 adult patients. The study, however, was a descriptive cross-sectional study, and self-reported measures of exposures and outcome were used, which may have led to bias away from the null. A meta-analysis of behavioral adjustments in children with asthma²⁷ and a systematic review of the relationship between atopic diseases and ADHD¹⁶ included many studies that observed a positive association between these atopic disorders and ADHD; however, some studies did not observe such an association.^{28,29} These conflicting results may have been caused by methodologic differences, such as the use of a descriptive cross-sectional design or the presence of selection bias.¹⁶ Our study was designed to identify potential etiologic factors using a case-control study where exposures recorded before the diagnosis of ADHD were compared with exposures in control patients without ADHD.³⁰ The study was also designed to control for multiple confounders and biases, including selection bias.³⁰

The incidence of impetigo during the last decade has paralleled the increase in atopic diseases. In England from 1989 to 2004 hospital admission rates for impetigo increased 5-fold across all age groups and even 12-fold among those 5 to 14 years old, the age group of our study.¹⁰ The high prevalence was confirmed in our study, in which impetigo was present in 1 in 7 children in the control group. Importantly, impetigo has been associated with

atopic dermatitis²¹ but has never been studied in relation to ADHD. In a systematic review of the association between atopic dermatitis and ADHD, Gee and colleagues³¹ found that in 4 of 6 observational studies there was an association; in 2 studies the odds ratio exceeded 4. However, these prior studies were criticized because of a lack of adjustment for confounding and the application of a cross-sectional design. In our study we observed a nearly statistically significant positive association between atopic dermatitis and ADHD and a highly statistically significant association with impetigo, which also points at a possible shared origin.

Strengths of our study include the use of the GPRD, which is large and representative of the United Kingdom and contains virtually complete and accurate data on diagnoses and prescriptions. The restriction to male patients prevented any potential distortion by sex because it is well known that both ADHD and atopic disease are more common in boys than girls.^{6,21} The availability of medical history information for at least 3 years before the index date prevented the potential for differential exposure and outcome information among cases and controls. We were able to control for confounding by restricting the analysis to boys and by matching on age and general practice and adjustment for history of low birth weight and preterm delivery, which are strong risk factors for both asthma and ADHD.¹⁴

Despite these strengths, potential limitations must be considered in the interpretation of these results. It is possible that selection bias may have occurred if those who had a diagnosis of an atopic disorder or skin infection also had a higher probability of being diagnosed as having ADHD. We tried to minimize this type of bias by also including medical drug treatment in the case definition to ensure that only the more severe cases were included in the study. Treatment with methylphenidate or atomoxetine is advised only in severe cases where behavioral interventions, such as psychoeducation, parent training, and child behavioral interventions, are insufficient to control symptoms.¹ Because approximately 50% of all ADHD cases in the database were not using methylphenidate, we are unsure how the associations with atopic diseases would be, and future studies are needed to detect possible subgroup effects across treated and untreated ADHD cases. For statistical reasons, we also did not examine subgroup effects across sex and those ADHD cases with and without autism, which may need further study in the future. A limitation might be that we included boys who were first diagnosed as having ADHD during the years 1996 to 2006, which is after the first reports on a potential association between atopic disorders and ADHD. It may therefore be possible that general practitioners were more inclined to detect ADHD in those with atopic disease during the study period. However, when we restricted the analyses to boys with a medical history of conjunctivitis to further minimize potential differential diagnostic bias, the increased risks remained. Some children who develop ADHD do not seek medical attention, so we may have missed some cases, but misclassification would likely have been random and would not explain the results found in this case-control study.³⁰ Information on risk factors, such as socioeconomic status of the parents, dietary factors, maternal smoking, breastfeeding, genetic predisposition, or environmental air conditions, was not available; thus, it is possible that there is some residual confounding in our study. However, matching on general practice prevented some of the environmental confounding, and there would have to be a large difference between cases and controls in the prevalence of these unmeasured factors to explain our results, which is unlikely. Finally, the control population of this matched case-control study has a high prevalence of asthma diagnosis and use of respiratory medication. First, the analyses are limited to boys, who in general have higher risks of asthma development than girls. Second, a criterion for both cases and controls is that there should be any medical information in the record at least in the 3 years before the index date. Such a criterion

selects both cases and controls that have consulted the general practitioner. This may have led to a higher prevalence rate in both groups, notably in the control group without ADHD; hence, we may have underestimated the actual associations.

In summary, our study provides additional evidence to support the hypothesis that atopic disorders, such as asthma and (food) allergies, increase the risk of developing ADHD. Further interdisciplinary research is needed to understand the underlying mechanisms and to evaluate targeted preventive, diagnostic, and therapeutic interventions.

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Supplementary Data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.anai.2013.05.023>

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eAppendix. Read code lists**Read Code List for Low Birth Weight and/or Prematurity**

Q432.00 PRETERM DELIVERY JAUNDICE
 Q10z.00 FETAL GROWTH RETARDATION NOS
 Q10z.11 INTRAUTERINE GROWTHRETARDATION
 Q11.00 SHORTGEST AND UNSPECLOWBIRT
 Q11.11 BABY BORN PREMATURE
 Q110.00 VERY PREMATUREOR LESS
 Q110.11 IMMATURE BABY
 Q111.00 PREMATURE - WEIGHTG OR GESTAT
 Q112.00 EXTREME IMMATURITY
 Q112.11 EXTREME PREMATURITY 28 WEEKS
 Q113.00 LIGHT FOR GESTATIONAL AGE
 Q114.00 LOW BIRTHWEIGHT
 Q114000 BIRTH WEIGHT 1000-2499 G
 Q115.00 EXTREMELY LOW BIRTHWEIGHT
 Q116.00 PREMATURE INFANT 28-37 WEEKS
 Q11z.00 BORN PREMATURE NOS
 1546.00 H/O: PREMATURE DELIVERY
 635..13 PREMATURE BABY
 6353.00 BABY EXTREMELY PREM.28-32 WEEK
 6361.00 BABY BW = < 3% (UNDER 2500G)

Read Code List for Asthma

173A.00 EXERCISE INDUCED ASTHMA
 663..11 ASTHMA MONITORING
 663N.00 ASTHMA DISTURBING SLEEP
 663N000 ASTHMA CAUSING NIGHT WAKING
 663N100 ASTHMA DISTURBS SLEEP WEEKLY
 663N200 ASTHMA DISTURBS SLEEP FREQUENTLY
 663O.00 ASTHMA NOT DISTURBING SLEEP
 663O000 ASTHMA NEVER DISTURBS SLEEP
 663P.00 ASTHMA LIMITING ACTIVITIES
 663Q.00 ASTHMA NOT LIMITING ACTIVITIES
 663U.00 ASTHMA MANAGEMENT PLAN GIVEN
 663V.00 ASTHMA SEVERITY
 663V000 OCCASIONAL ASTHMA
 663V100 MILD ASTHMA
 663V200 MODERATE ASTHMA
 663V300 SEVERE ASTHMA
 663W.00 ASTHMA PROPHYLACTIC MEDICATION USED
 663d.00 EMERGENCY ASTHMA ADMISSION SINCE LAST APPOINTMENT
 663e.00 ASTHMA RESTRICTS EXERCISE
 663e000 ASTHMA SOMETIMES RESTRICTS EXERCISE
 663e100 ASTHMA SEVERELY RESTRICTS EXERCISE
 663f.00 ASTHMA NEVER RESTRICTS EXERCISE
 663h.00 ASTHMA - CURRENTLY DORMANT
 663j.00 ASTHMA - CURRENTLY ACTIVE
 8793.00 ASTHMA CONTROL STEP 0
 8794.00 ASTHMA CONTROL STEP 1
 8795.00 ASTHMA CONTROL STEP 2
 8796.00 ASTHMA CONTROL STEP 3
 8797.00 ASTHMA CONTROL STEP 4
 8798.00 ASTHMA CONTROL STEP 5
 8H2P.00 EMERGENCY ADMISSION, ASTHMA
 90J1.00 ATTENDS ASTHMA MONITORING
 90J2.00 REFUSES ASTHMA MONITORING
 90J3.00 ASTHMA MONITOR OFFER DEFAULT
 90J4.00 ASTHMA MONITOR 1ST LETTER
 90J5.00 ASTHMA MONITOR 2ND LETTER
 90J6.00 ASTHMA MONITOR 3RD LETTER
 90J7.00 ASTHMA MONITOR VERBAL INVITE
 90J8.00 ASTHMA MONITOR PHONE INVITE
 90J9.00 ASTHMA MONITORING DELETED

90JA.00 ASTHMA MONITORING CHECK DONE
 90JA.11 ASTHMA MONITORED
 90JZ.00 ASTHMA MONITORING ADMIN.NOS
 9Q21.00 PATIENT IN ASTHMA STUDY
 H33..00 ASTHMA
 H33..11 BRONCHIAL ASTHMA
 H330.00 EXTRINSIC (ATOPIC) ASTHMA
 H330.11 ALLERGIC ASTHMA
 H330.12 CHILDHOOD ASTHMA
 H330.13 HAY FEVER WITH ASTHMA
 H330.14 POLLEN ASTHMA
 H330000 EXTRINSIC ASTHMA WITHOUT STATUS ASTHMATICUS
 H330011 HAY FEVER WITH ASTHMA
 H330100 EXTRINSIC ASTHMA WITH STATUS ASTHMATICUS
 H330111 EXTRINSIC ASTHMA WITH ASTHMA ATTACK
 H330z00 EXTRINSIC ASTHMA NOS
 H331.00 INTRINSIC ASTHMA
 H331.11 LATE ONSET ASTHMA
 H331000 INTRINSIC ASTHMA WITHOUT STATUS ASTHMATICUS
 H331100 INTRINSIC ASTHMA WITH STATUS ASTHMATICUS
 H331111 INTRINSIC ASTHMA WITH ASTHMA ATTACK
 H331z00 INTRINSIC ASTHMA NOS
 H332.00 MIXED ASTHMA
 H333.00 ACUTE EXACERBATION OF ASTHMA
 H33z.00 ASTHMA UNSPECIFIED
 H33z000 STATUS ASTHMATICUS NOS
 H33z011 SEVERE ASTHMA ATTACK
 H33z100 ASTHMA ATTACK
 H33z111 ASTHMA ATTACK NOS
 H33z200 LATE-ONSET ASTHMA
 H33zz00 ASTHMA NOS
 H33zz11 EXERCISE INDUCED ASTHMA
 H33zz12 ALLERGIC ASTHMA NEC
 H35y700 WOOD ASTHMA
 H47y000 DETERGENT ASTHMA
 H312000 CHRONIC ASTHMATIC BRONCHITIS

Antiasthmatic Medications

2 Fluticasone + salmeterol I
 Aminophylline
 Bambuterol
 Beclomethasone dipropionate
 Beclomethasone with salbutamol
 Betamethasone
 Betamethasone sodium phosphate
 Budesonide
 Budesonide + eformoterol
 Ciclesonide
 Eformoterol
 Fenoterol hydrobromide
 Fenoterol hydrobromide with ipratropium
 Fluticasone
 Fluticasone + salmeterol I
 Formoterol fumarate
 Ipratropium bromide inhaler and spray
 Isoetharine
 Isoetharine with phenylephrine
 Isoprenaline with atropine
 Isoproterenol hydrochloride, phenyl
 Isoproterenol inhalation
 Isoproterenol tablets/injection
 Metaproterenol sulfate
 Methoxyphenamine hydrochloride
 Mometasone furoate
 Montelukast sodium
 Nedocromil

Orciprenaline with bromhexine
 Pirbuterol
 Reproterol
 Rimiterol
 Salbutamol sulfate
 Salbutamol with ipratropium
 Salmeterol
 Sodium cromoglycate with isoprenaline
 Terbutaline sulfate
 Terbutaline with guaifenesin
 Theophylline, ephedrine, phenobarbital
 Tulobuterol
 Zafirlukast

Antihistamine Medications

Acrivastine
 Antazoline hydrochloride
 Astemizole
 Azatadine
 Brompheniramine maleate
 Brompheniramine, glycine guaifenesin
 Brompheniramine, phenylephrine
 Buclizine with nicotinic AC
 Buclizine, codeine, DUCU
 Cetirizine
 Chlorpheniramine
 Clemastine fumarate
 Cyclizine hydrochloride
 Cyproheptadine hydrochloride
 Desloratadine
 Dexbrompheniramine with ISO
 Dimenhydrinate
 Dimethindene maleate
 Diphenhydramine
 Diphenylpyraline hydrochloride
 Fexofenadine hydrochloride
 Ketotifen
 Levocetirizine
 Loratadine
 Mebhydrolin napadisylate
 Meclizine
 Meclizine with pyridoxine
 Meclozine hydrochloride
 Mequitazine
 Mizolastine
 Oxatomide
 Phenindamine
 Pheniramine

Promethazine
 Promethazine with codeine
 Pseudoephedrine with brompheniramine
 Pyrilamine maleate
 Terfenadine
 Thiethylperazine maleate
 Trimoprazine tartrate
 Tripeleminamine with ephedrine
 Tripolidine

Antifungals

Amorolfine
 Clotrimazole
 Econazole
 Fluconazole
 Griseofulvin
 Itraconazole
 Ketoconazole
 Miconazole
 Nystatin
 Terbinafine
 Tioconazole

Antibacterials

Hydrogen peroxide
 Magnesium sulfate
 Metronidazole
 Mupirocin
 Neomycin
 Potassium permanganate
 Retapamulin
 Sodium fusidate

Topical steroids

Alclometasone
 Betamethasone
 Clobetasol
 Clobetasone
 Clobetasone
 Diflucortolone
 Fluocinolone
 Fluocinolone
 Fluocinolone
 Fluticasone
 Hydrocortisone
 Hydrocortisone
 Mometasone