

PRODUCT MONOGRAPH

Ibuprofen + Pseudoephedrine Caplets

Ibuprofen and Pseudoephedrine Hydrochloride Tablets USP
Ibuprofen 200 mg, Pseudoephedrine Hydrochloride 30 mg

Caplets

Analgesic/Antipyretic/Nasal Decongestant

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Ibuprofen+Pseudoephedrine Caplets

Ibuprofen and Pseudoephedrine Hydrochloride Tablets USP

PART I: HEALTH PROFESSIONAL INFORMATION

SUMMARY PRODUCT INFORMATION

Route of Administration	Dosage Form / Strength	Clinically Relevant Nonmedicinal Ingredients
Oral	Caplet: 200 mg Ibuprofen and 30 mg Pseudoephedrine Hydrochloride	<i>For a complete listing see Dosage Forms, Composition and Packaging section.</i>

INDICATIONS AND CLINICAL USE

Ibuprofen+Pseudoephedrine Caplets is indicated for:

- the temporary relief of symptoms associated with the common cold, including nasal congestion, headache, fever, and minor body aches and pains.

Ibuprofen+Pseudoephedrine Caplets (ibuprofen 200 mg, pseudoephedrine hydrochloride 30 mg) is a non-prescription analgesic and nasal decongestion preparation.

Geriatrics (> 65 years of age):

Evidence from clinical studies and experience suggests that use in the geriatric population is associated with differences in safety or effectiveness. Therefore the use of Ibuprofen+Pseudoephedrine caplets in this population is not recommended. (*See Warnings and Precautions and Dosage and Administration*)

Children (< 12 years of age):

Ibuprofen+Pseudoephedrine caplets is not indicated for children <12 years of age.

CONTRAINDICATIONS

- Active peptic ulcer, a history of recurrent ulceration or active inflammatory disease of the gastrointestinal system, such as ulcerative colitis and Crohn's disease.
- Known or suspected hypersensitivity to ibuprofen or other non-steroidal anti-inflammatory (NSAID) drugs. Patients who are hypersensitive to this drug or any ingredient in the formulation or component of the container. For a complete listing, see Dosage Forms, Composition and Packaging section of the product monograph. The potential for cross-reactivity between different

NSAIDs must be kept in mind.

- Ibuprofen+Pseudoephedrine Caplets should not be used in patients with the complete or partial syndrome of nasal polyps, or in whom asthma, anaphylaxis, bronchospastic reaction, urticaria, rhinitis or other allergic manifestations are precipitated by acetylsalicylic acid (ASA) or other nonsteroidal anti-inflammatory agents. Fatal anaphylactoid reactions have occurred in such individuals. As well, individuals with the above medical problems are at risk of a severe reaction even if they have taken NSAIDs in the past without any adverse effects.
- Significant hepatic impairment or active liver disease.
- Severely impaired or deteriorating renal function (creatinine clearance <30 mL/min). Individuals with lesser degrees of renal impairment are at risk of deterioration of their renal function when prescribed NSAIDs and must be monitored.
- Ibuprofen is not recommended for use with other NSAIDs because of the absence of any evidence demonstrating synergistic benefits and the potential for additive side effects (see *Drug Interactions*).
- Children (i.e. 18 years of age and younger) with kidney disease and children who have suffered significant fluid loss due to vomiting, diarrhea or lack of fluid intake, should not be given ibuprofen.
- Ibuprofen+Pseudoephedrine Caplets should not be used by patients who have known or suspected hypersensitivity to pseudoephedrine or other sympathomimetic amines, are taking or have taken monoamine oxidase inhibitor (MAOI) drugs within the last 14 days, have been diagnosed with severe hypertension, or have severe coronary artery disease [63] (*See Drug Interactions*).
- Ibuprofen should not be used during pregnancy or by nursing mothers.
- Ibuprofen is contraindicated in patients with systemic lupus erythematosus, as an anaphylaxis-like reaction with fever may occur, particularly when ibuprofen has been administered previously.
- Immediately before or following heart surgery.
- In patients with thyroid disease.
- In patients with Raynaud's Syndrome.

WARNINGS AND PRECAUTIONS

Serious Warnings and Precautions

- Patients with glaucoma or difficulty in urination due to enlargement of the prostate gland should not take this drug unless directed by a physician [64] (See *WARNINGS AND PRECAUTIONS, General*).
- Use with caution in patients with heart failure, hypertension or other conditions predisposing to fluid retention (See *WARNINGS AND PRECAUTIONS, Cardiovascular and Fluid and Electrolyte Balance; and DRUG INTERACTIONS, Antihypertensives*).
- Caution in patients who might be prone to gastrointestinal tract irritation, particularly those with a history of diverticulosis, or other inflammatory disease of the gastrointestinal tract such as ulcerative colitis and Crohn's disease (See *WARNINGS AND PRECAUTIONS, Gastrointestinal and DRUG INTERACTIONS, Coumarin-type anticoagulants*).
- Caution in patients at greatest risk of renal toxicity, such as those with impaired renal function, heart failure, liver dysfunction, those taking diuretics and the elderly (See *WARNINGS AND PRECAUTIONS, Renal*).
- If persistent urinary symptoms (bladder pain, dysuria, urinary frequency), hematuria and cystitis occur, the drug should be stopped immediately (See *WARNINGS AND PRECAUTIONS, Genitourinary*).>

General

As with other anti-inflammatory drugs, ibuprofen may mask the usual signs of infection.

If nervousness, dizziness, or sleeplessness occur, use of Ibuprofen+Pseudoephedrine Caplets should be discontinued and a physician should be consulted. Ibuprofen+Pseudoephedrine Caplets should not be used for more than 3 days for fever or 5 days for cold symptoms/pain.

Carcinogenesis and Mutagenesis

Not applicable.

Cardiovascular

Use of ibuprofen may precipitate congestive heart failure in patients with marginal cardiac function, elevated blood pressure and palpitations.

Ibuprofen+Pseudoephedrine Caplets should be used with caution in hypertensive patients because of the possible pressor effect of pseudoephedrine. Pseudoephedrine has been shown to increase blood pressure in normotensive adults and in patients with hypertension.

Pseudoephedrine treatment may increase heart rate and can cause arrhythmia. Asymptomatic, multifocal premature ventricular contractions (PVCs) were reported with the use of Actifed® (a combination of pseudoephedrine with an antihistamine, triprolidine), two tablets every 4 hours around the clock, for several days to treat nasal congestion [67]. The PVCs disappeared within a few days after discontinuation of the medication.

Dependence/Tolerance

Pseudoephedrine has the potential to cause drug dependency and withdrawal effects. Reportedly, a woman with a history of depression experienced a stimulatory effect from the use of 50 to 300 mL of Actifed® (pseudoephedrine and triprolidine) daily (the recommended dose is 30 mL per day) [75]. A 37-year-old woman admitted to taking 100 to 150 30-mg pseudoephedrine tablets daily [76]. She had gradually increased the daily dose over the previous 5 years to counteract chronic fatigue, apathy, and depression. A previous attempt to discontinue use of the drug had produced visual hallucinations, severe fatigue, and depression. Slow withdrawal by 200 to 300 mg/day resulted in a return of depressive symptoms; thereafter, the dose was decreased more slowly, by 90 mg/day. The patient was later diagnosed as having a mixed character disorder and reactive depression.

Ear/Nose/Throat

See Contraindications.

Endocrine and Metabolism

Patients with thyroid disease should not take this drug. See *Contraindications*.

Fluid and Electrolyte Balance

Fluid retention and oedema have been observed in patients treated with ibuprofen. Therefore, as with many other nonsteroidal anti-inflammatory drugs, the possibility of precipitating congestive heart failure in elderly patients or those with compromised cardiac function should be borne in mind. Ibuprofen+Pseudoephedrine Caplets should be used with caution in patients with heart failure, hypertension or other conditions predisposing to fluid retention.

With nonsteroidal anti-inflammatory treatment there is a potential risk of hyperkalemia, particularly in patients with conditions such as diabetes mellitus or renal failure; elderly patients; or in patients receiving concomitant therapy with B-adrenergic blockers, angiotensin converting enzyme inhibitors or some diuretics. Serum electrolytes should be monitored periodically during long-term therapy, especially in those patients who are at risk.

Gastrointestinal

See *Contraindications*. Serious GI toxicity, such as peptic ulceration, perforation and gastrointestinal bleeding, sometimes severe and occasionally fatal, can occur at any time, with or without symptoms in patients treated with NSAIDs including ibuprofen.

Minor upper GI problems, such as dyspepsia, are common, usually developing early in therapy. Physicians should remain alert for ulceration and bleeding in patients treated with non-steroidal anti-inflammatory drugs, even in the absence of previous GI tract symptoms.

In patients observed in clinical trials of such agents, symptomatic upper GI ulcers, gross bleeding, or perforation appear to occur in approximately 1% of patients treated for 3-6 months and in about 2-4% of patients treated for one year. The risk continues beyond one year and possibly increases. The incidence of these complications increases with increasing dose.

Ibuprofen+Pseudoephedrine Caplets should be given under close medical supervision to patients prone

to gastrointestinal tract irritation, particularly those with a history of peptic ulcer, diverticulosis or other inflammatory disease of the gastrointestinal tract such as ulcerative colitis and Crohn's disease. In these cases the physician must weigh the benefits of treatment against the possible hazards.

Physicians should inform patients about the signs and/or symptoms of serious GI toxicity and instruct them to contact a physician immediately if they experience persistent dyspepsia or other symptoms or signs suggestive of gastrointestinal ulceration or bleeding. Because serious GI tract ulceration and bleeding can occur without warning symptoms, physicians should follow chronically treated patients by checking their haemoglobin periodically and by being vigilant for the signs and symptoms of ulceration and bleeding and should inform the patients of the importance of this follow-up.

If ulceration is suspected or confirmed, or if GI bleeding occurs, Ibuprofen+Pseudoephedrine Caplets should be discontinued immediately, appropriate treatment instituted and the patient monitored closely.

No studies, to date, have identified any group of patients not at risk of developing ulceration and bleeding. A prior history of serious GI events and other factors such as excess alcohol intake, smoking, age, female gender and concomitant oral steroid and anticoagulant use have been associated with increased risk. Studies to date show that all NSAIDs can cause GI tract adverse events. Although existing data does not clearly identify differences in risk between various NSAIDs, this may be shown in the future.

There is no definitive evidence that the concomitant administration of histamine H₂-receptor antagonists and/or antacids will either prevent the occurrence of gastrointestinal side effects or allow the continuation of Ibuprofen+Pseudoephedrine Caplets therapy when and if these adverse reactions appear.

Ischemic colitis has been reported in association with the use of pseudoephedrine. In four separate cases, perimenopausal women had ingested varying quantities of pseudoephedrine (60 mg or more daily) for treatment of upper respiratory disorders [65]. All patients had taken pseudoephedrine within the week preceding symptom onset, and all patients presented with complaints of acute onset abdominal pain associated with fresh blood in the stool. Colonoscopy revealed in each case a segmental colitis characterized by oedematous, hyperaemic colonic mucosa, most often in the region of the splenic flexure, yet also extending upward to involve the transverse colon. Several occurrences of frank mucosal haemorrhage were observed. Biopsy samples of mucosa revealed acute inflammatory changes consistent with ischemic colitis. In each case, the patient recovered without further incident or recurrence after pseudoephedrine was discontinued.

Genitourinary

Some NSAIDs are known to cause persistent urinary symptoms (bladder pain, dysuria, urinary frequency), hematuria or cystitis. The onset of these symptoms may occur at any time after the initiation of therapy with an NSAID. Some cases have become severe on continued treatment. Should urinary symptoms occur, treatment with Ibuprofen+Pseudoephedrine Caplets must be stopped immediately to obtain recovery. This should be done before any urological investigations or treatments are carried out.

Hematologic

NSAIDs inhibiting prostaglandin biosynthesis do interfere with platelet function to varying degrees; patients who may be adversely affected by such an action, such as those on anticoagulants or suffering from haemophilia or platelet disorders, should be carefully observed when ibuprofen is administered.

Blood dyscrasias (such as neutropenia, leukopenia, thrombocytopenia, aplastic anaemia and agranulocytosis) associated with the use of non-steroidal anti-inflammatory drugs are rare, but could occur with severe consequences.

Hepatic/Biliary/Pancreatic

As with other nonsteroidal anti-inflammatory drugs, borderline elevations of one or more liver function tests (AST, ALT, alkaline phosphatase) may occur in up to 15% of patients. These abnormalities may progress, may remain essentially unchanged, or may be transient with continued therapy. A patient with symptoms and/or signs suggesting liver dysfunction, or in whom an abnormal liver test has occurred, should be evaluated for evidence of the development of more severe hepatic reaction while on therapy with this drug. Severe hepatic reactions including jaundice and cases of fatal hepatitis and liver necrosis have been reported with nonsteroidal anti-inflammatory drugs.

Although such reactions are rare, if abnormal liver tests persist or worsen, if clinical signs and symptoms consistent with liver disease develop, or if systemic manifestations occur (*e.g.* eosinophilia, rash, etc.), this drug should be discontinued.

During long-term therapy, liver function tests should be monitored periodically. If there is a need to prescribe this drug in the presence of impaired liver function, it must be done under strict observation.

The frequency of acute liver injury among 625,307 people who received NSAIDs in England and Wales between 1987 and 1991, was examined [73]. There were 311,716 patients who were prescribed ibuprofen. The incidence of acute liver injury among ibuprofen users was 1.6/100,000; this was the lowest incidence among the 8 NSAIDs studied and was significantly lower than the incidence among users of ketoprofen, piroxicam, fenbrufen, or sulindac. For NSAID users as a group, the only factors that had an independent effect on the occurrence of acute liver injury were the simultaneous use of hepatotoxic medication or the presence of rheumatoid arthritis. Based on these data, the short-term use of ibuprofen as an analgesic/antipyretic should not be of concern regarding the development of liver disease.

Immune

Patients with complete or partial syndrome of nasal polyps, rhinitis or other allergic manifestations should not use ASA or other anti-inflammatory agents. Fatal anaphylactoid reactions have occurred in such individuals even if they have taken NSAIDs in the past without any adverse effects (See *Contraindications*).

In occasional cases, with some NSAIDs, the symptoms of aseptic meningitis (stiff neck, severe headaches, nausea and vomiting, fever or clouding of consciousness) have been observed. Patients with autoimmune disorders (systemic lupus erythematosus, mixed connective tissue diseases, etc.) seem to be pre-disposed. Therefore, in such patients, the physician must be vigilant to the development of this complication.

Neurologic

Some patients may experience drowsiness, dizziness, vertigo, insomnia or depression with the use of

ibuprofen. If patients experience these side effects, they should exercise caution in carrying out activities that require alertness.

High plasma concentrations of phenylalanine in individuals with phenylketonuria may exacerbate the CNS effects of pseudoephedrine.

Ophthalmologic

Blurred and/or diminished vision has been reported with the use of ibuprofen and other nonsteroidal anti-inflammatory drugs. If such symptoms develop this drug should be discontinued and an ophthalmologic examination performed; ophthalmic examination should be carried out at periodic intervals in any patient receiving this drug for an extended period of time.

Patients with glaucoma should be closely monitored.

Peri-Operative Considerations

See *Contraindications*. In general NSAIDs are discontinued prior to surgeries to decrease the risk of post-operative bleeding [161].

Psychiatric

See *Warnings* and *Precautions*, Neurologic.

Renal

Long term administration of nonsteroidal anti-inflammatory drugs to animals has resulted in renal papillary necrosis and other abnormal renal pathology. In humans, there have been reports of acute interstitial nephritis with hematuria, proteinuria, and occasionally nephrotic syndrome.

A second form of renal toxicity has been seen in patients with prerenal conditions leading to the reduction in renal blood flow or blood volume, where the renal prostaglandins have a supportive role in the maintenance of renal perfusion. In these patients, administration of a nonsteroidal anti-inflammatory drug may cause a dose dependent reduction in prostaglandin formation and may precipitate overt renal decompensation. Patients at greatest risk of this reaction are those with impaired renal function, heart failure, liver dysfunction, those taking diuretics, and the elderly. Discontinuation of nonsteroidal anti-inflammatory therapy is usually followed by recovery to the pre-treatment state.

Ibuprofen and its metabolites are eliminated primarily by the kidneys; therefore the drug should be used with great caution in patients with impaired renal function. In these cases, utilisation of lower doses of Ibuprofen+Pseudoephedrine Caplets should be considered and patients carefully monitored.

During long-term therapy kidney function should be monitored periodically.

Pseudoephedrine and its active metabolite are excreted chiefly via the kidneys [33]. Therefore, dosage should be adjusted in patients with impaired kidney function. Myoclonic jerking and bizarre behaviour were reported in a hemodialysis patient with end-stage renal failure after taking 60 mg of pseudoephedrine four times daily for 12 days to treat nasal congestion [70].

Respiratory

Patients with asthma should not use ASA or other nonsteroidal anti-inflammatory agents. Fatal

anaphylactoid reactions have occurred in such individuals even if they have taken NSAIDs in the past without any adverse effects (see *Contraindications*).

Sensitivity/Resistance

Patients sensitive to any one of the nonsteroidal anti-inflammatory drugs may be sensitive to any of the other NSAIDs also.

Sexual Function/Reproduction

Not applicable.

Skin

Pseudoephedrine may induce non-pigmenting, fixed-type skin eruptions, which are typically indurated, erythematous, pruritic, tender, and oedematous. The reaction tends to occur within 24 hours after administration of pseudoephedrine and to resolve 2 to 3 days after discontinuation.

Special Populations

Pregnant Women: Ibuprofen+Pseudoephedrine Caplets is contraindicated for use during pregnancy.

Nursing Women: Ibuprofen+Pseudoephedrine Caplets is contraindicated for use during nursing.

Pediatrics: Ibuprofen+Pseudoephedrine Caplets is not indicated for children less than 12 years of age.

Geriatrics (> 65 years of age):

Patients older than 65 years and frail or debilitated patients are most susceptible to a variety of adverse reactions from nonsteroidal anti-inflammatory drugs (NSAIDs): the incidence of these adverse reactions increases with dose and duration of treatment. In addition, these patients are less tolerant to ulceration and bleeding. Most reports of fatal GI events are in this population. Older patients are also at risk of lower oesophageal ulceration and bleeding. There is also increased susceptibility to effects of sympathomimetic amines observed in elderly patients.

Ibuprofen+Pseudoephedrine Caplets are not indicated for use in patients over 65 years of age.

Monitoring and Laboratory Tests

For *Warnings And Precautions* related to the use of Ibuprofen+Pseudoephedrine Caplets and *Monitoring and Laboratory Tests* see *Fluid and Electrolyte Balance, Gastrointestinal, Hematologic, Hepatic, Renal and Subpopulations: Elderly*.

ADVERSE REACTIONS

Clinical Trial Adverse Drug Reactions

Because clinical trials are conducted under very specific conditions the adverse reaction rates observed in the clinical trials may not reflect the rates observed in practice and should not be compared to the

rates in the clinical trials of another drug. Adverse drug reaction information from clinical trials is useful for identifying drug-related adverse events and for approximating rates.

Safety Studies of Ibuprofen and Pseudoephedrine Combination

In patients with upper respiratory infections treated with either ibuprofen 200 mg plus pseudoephedrine 30 mg (n = 294), acetaminophen 500 mg (n = 296), or placebo (n = 146), the frequency of adverse events (mostly gastrointestinal and CNS symptoms) was similar among the three treatment groups [83].

In a placebo-controlled, double-blind clinical study of 58 subjects with rhinovirus infection, pseudoephedrine given alone or with ibuprofen was well tolerated [84]. Symptoms associated with sympathetic stimulation tended to be more frequent in subjects who were treated with pseudoephedrine (60 mg, either alone or with 200 mg ibuprofen) than in those who received placebo. The three treatment groups were similar in mean pulse rate and mean blood pressure.

Safety Studies of Ibuprofen:

The results of a double-blind, placebo-controlled study in healthy subjects (N = 1246) representative of a non-prescription analgesic user population indicate that ibuprofen at a dosage of 1200 mg/day for 10 consecutive days is well tolerated [85]. The frequency of gastrointestinal adverse experiences was similar in the placebo and ibuprofen groups (16% with placebo vs. 19% with ibuprofen). The most frequent gastrointestinal adverse experiences (those reported by 1% of the subjects) were dyspepsia, abdominal pain, nausea, diarrhoea, flatulence, and constipation. There was no difference between the two groups in the proportion discontinuing treatment because of gastrointestinal adverse events. Seventeen subjects (1.4%) had positive occult blood tests: the frequency was comparable for the two treatments.

In two multital analyses [86,87], a meta analysis [88], and a literature review [89], ibuprofen had a low incidence of gastrointestinal drug reactions, comparable with that of acetaminophen and placebo. In epidemiological studies, ibuprofen has consistently exhibited the lowest relative risk of severe gastrointestinal complications compared with other NSAIDs and acetylsalicylic acid [90,91,92]. No symptom or syndrome emerged in the trials that was not predicted from the drug's pharmacology or could not have been anticipated based on ibuprofen's extensive use as an analgesic/antipyretic in adults. Garcia-Rodriguez reported on the frequency of acute liver injury among 625,307 people who received NSAIDs in England and Wales between 1987 and 1991, of whom 311,716 were prescribed ibuprofen [93]. The incidence of acute liver injury among ibuprofen users was 1.6/100,000. This was the lowest incidence among the eight NSAIDs studied and was significantly lower than the incidence among users of ketoprofen, piroxicam, fenbufen, or sulindac. For NSAID users as a group, the only factors that had an independent effect on the occurrence of acute liver injury were simultaneous use of hepatotoxic medication and the presence of rheumatoid arthritis.

Two large-scale safety studies of ibuprofen examined the potential risk in children of several rare events that are related to the pharmacological action of NSAIDs: GI bleeding, acute renal failure, and anaphylaxis.

The Children's Analgesic Medicine Project (CAMP) was a multicenter, all-comers, open-label, nonrandomized, prospective study comparing the safety of ibuprofen suspension with acetaminophen suspension in children with fever and/or pain [94]. A total of 424 pediatricians enrolled children at 69

US clinics; 14,281 were <2 years of age and 15,863 were 2 to <12 years of age. Among children <2 years of age, fever, vomiting, diarrhoea, rhinitis, rash, and otitis media were the only adverse events with frequency >1% in either treatment group (ibuprofen or acetaminophen). Among children 2 years of age, the only adverse events with frequency >1% in either treatment group were rhinitis, pharyngitis, and otitis media. Adverse events were generally mild to moderate for both treatments within the two age groups. There were no serious adverse events, (no anaphylaxis, Reye syndrome, renal failure, or GI bleeding/perforation). The percentage of younger children with adverse events was slightly higher in the ibuprofen group (17.6% vs. 15.0%); similar results were seen in the older children (11.9% vs. 10.7%). The difference may have been due to the preference of physicians to treat the sicker children with ibuprofen. Overall, ibuprofen exhibited an adverse event profile similar to that of acetaminophen.

The Boston Fever Study was a randomized, double-blind study that assessed the risk of rare but serious adverse events after the use of ibuprofen suspension in febrile children between 6 months and 12 years of age [95,96,97]. The study evaluated a total of 83,915 children enrolled by 1735 pediatricians, family physicians, and general practitioners in the United States. Children were randomly assigned to receive ibuprofen suspension 5 mg/kg (N = 27,948), ibuprofen suspension 10 mg/kg (N = 27,837), or acetaminophen suspension 12 mg/kg (N = 28,130). Medications were given every 4 to 6 hours, as needed, for a total of up to five doses per day. The study recorded hospitalisations for acute GI bleeding, acute renal failure, and anaphylaxis and monitored for the occurrence of Reye syndrome. In the entire population, the authors found no significant difference between ibuprofen and acetaminophen-treated children in the observed risk of GI bleeding, acute renal failure, or anaphylaxis. No cases of Reye syndrome were seen.

Adverse Events with Doses of Ibuprofen \geq 1200 mg/day:

Gastrointestinal

In clinical trials of NSAIDs, symptomatic upper GI ulcers, gross bleeding, or perforation occurred in approximately 1% of patients treated for 3–6 months and in about 2–4% of patients treated for 1 year. The risk continues beyond 1 year. The incidence of GI complications increases with increasing dose. Incidence 3–9%: nausea, epigastric pain, heartburn. Incidence 1–3%: diarrhoea, abdominal distress, nausea and vomiting, indigestion, constipation, abdominal cramps or pain, fullness of the gastrointestinal tract (bloating or flatulence). Incidence <1%: gastric or duodenal ulcer with bleeding and/or perforation, gastrointestinal haemorrhage, melena, hepatitis, jaundice, abnormal liver function (SGOT, serum bilirubin and alkaline phosphatase).

Allergic

Incidence <1%: anaphylaxis (see Contraindications). Causal relationship unknown: fever, serum sickness, lupus erythematosus.

Central Nervous System

Incidence 3–9%: dizziness. Incidence 1–3%: headache, nervousness. Incidence <1%: depression, insomnia. Causal relationship unknown: paraesthesias, hallucinations, abnormal dreams.

Aseptic meningitis and meningoencephalitis, in one case accompanied by eosinophilia in the cerebrospinal fluid, have been reported in patients who took ibuprofen intermittently and did not have any connective tissue disease.

Dermatologic

Incidence 3-9%: rash (including maculopapular type). Incidence 1-3%: pruritus. Incidence <1%: vesiculobullous eruptions, urticaria, erythema multiforma. Causal relationship unknown: alopecia, Stevens-Johnson syndrome.

Cardiovascular

Incidence <1%: congestive heart failure in patients with marginal cardiac function, elevated blood pressure, palpitations. Causal relationship unknown: arrhythmias (sinus tachycardia, sinus bradycardia, palpitations).

Special Senses

Incidence 1-3%: tinnitus. Incidence <1%: amblyopia (blurred and/or diminished vision, scotomata, and/or changes in colour vision). Causal relationship unknown: conjunctivitis, diplopia, optic neuritis.

Haematologic

Incidence <1%: leukopenia, decreases in haemoglobin and haematocrit. Causal relationship unknown: haemolytic anaemia, thrombocytopenia, granulocytopenia, bleeding episodes (e.g., purpura, epistaxis, haematuria, menorrhagia).

Hepatic

Liver enzyme elevations may occur in up to 15% of patients treated with ibuprofen.

Renal

Acute interstitial nephritis with hematuria, proteinuria, and occasionally nephrotic syndrome have been reported. Renal papillary necrosis has been reported. Causal relationship unknown: decreased creatinine clearance, polyuria, azotemia.

Endocrine

Causal relationship unknown: gynecomastia, hypoglycaemic reaction. Menstrual delays of up to 2 weeks and dysfunctional uterine bleeding occurred in nine patients taking ibuprofen, 400 mg t.i.d., for three days before menses.

Metabolic

Incidence 1-3%: decreased appetite, oedema, fluid retention.

Post-Market Adverse Drug Reactions**Spontaneously Reported Adverse Events for Ibuprofen/Pseudoephedrine Products:**

Since the inception of marketing of combination ibuprofen/pseudoephedrine products, more than 3 billion doses have been distributed in the United States alone. During the period from 1989 to 2000, 411 reports were received describing 699 adverse drug reactions world wide for all marketed products containing ibuprofen and pseudoephedrine in combination. Fifty-three of the reports were associated with a serious outcome, usually hospitalisation. One death was reported; in the reporter's opinion, the death was related to staphylococcal septicaemia and not to ibuprofen/ pseudoephedrine. Table 1 lists the events that were spontaneously reported three or more times, by body system and preferred term from a coding dictionary (COSTART in most cases; also MedDRA).

Table 1 Adverse Events Reported Spontaneously Three or More Times with Use of Ibuprofen/Pseudoephedrine-Containing Products (August, 1989 to December 31, 2000)

Body System	Preferred Term	Number of Events
Body as a whole	Allergic reaction	13
	Anaphylaxis	3
	Asthenia	11
	Fever	6
	Headache	9
	Malaise	4
	No drug effect	132
	Oedema, face	14
	Overdose	3
	Pain	7
	Pain, abdomen	10
	Reaction, aggravated	6
	Reaction, unevaluated	9
Cardiovascular system	Fibrillation, atrial	3
	Hemorrhage, cerebral	3
	Hypertension	12
	Hypotension	3
	Ischemia,, cerebral	3
	Palpitations	6
	Tachycardia	5
	Vasodilation	12
Digestive system	Diarrhoea	4
	Dyspepsia	11
	Melena	4
	Nausea	17
	Vomiting	9
Haemic and lymphatic	Purpura, thrombopenic	3
	Thrombocytopenia	4
Metabolic and nutritional	Oedema, peripheral	3
Musculoskeletal	Twitch	6
Body System	Preferred Term	Number of Events
Nervous system	Dizziness	29
	Euphoria	4
	Insomnia	26
	Nervousness	16
	Paraesthesia	4
	Somnolence	13
	Tremor	3
Respiratory system	Asthma	3
	Dyspnoea	10
	Epistaxis	5
	Rhinitis	10

Skin and appendages	Angioedema	9
	Pruritus	22
	Rash	30
	Rash, maculopapular	12
	Sweating	5
	Urticaria	15
Special Senses	Diplopia	4
	Parosmia	3
	Tinnitus	3
	Vision abnormal	3
Urogenital system	Urinary retention	6

Safety Data on Pseudoephedrine from Case Reports

Hyperthermia

A 21-year-old man who was taking pseudoephedrine for weight loss died suddenly after receiving heat-phenol-inactivated typhoid vaccine and Japanese encephalitis vaccine [98]. While on a 3-mile run 75 minutes after the inoculation, he collapsed and was found pulseless and apnoeic. He was in asystole, with a rectal temperature of 42.2°C. External pacing, cooling, and resuscitation efforts were unsuccessful. There was no evidence of urticaria, angioedema, heart failure, thrombosis, cerebral oedema, or petechial hemorrhage. The sympathomimetic effects of pseudoephedrine may have decreased the cooling ability of the body and increased susceptibility to heat-related adverse effects. The combined pyrogenic effects of the vaccines, exercise, mild obesity, and an impaired thermoregulatory system may have contributed to the patient's death.

Cardiovascular Adverse Reactions

Hypertension and loss of consciousness were reported in a 17-year-old man within 30 minutes after ingestion of one tablet of pseudoephedrine 60 mg [99]. Blood pressure on admission was 170/110 mmHg, pulse was 124 beats per minute, and the patient was unresponsive to painful stimuli. Approximately 1 hour after ingestion of pseudoephedrine, the patient awoke spontaneously. Blood pressure was 124/80 mmHg; pulse was 96 beats per minute. Pseudoephedrine may have induced a state of relative cerebral ischemia secondary to carotid vasoconstriction.

Postural hypotension was reported in a 28-year-old male airplane pilot after administration of pseudoephedrine 60 mg three times daily for 2 days. Physical examination revealed a supine blood pressure of 115/74 mmHg, which fell to 96/60 upon standing and was associated with dizziness lasting 10 to 15 seconds. Symptoms disappeared after discontinuation of pseudoephedrine and recurred upon rechallenge [100].

Pseudoephedrine was reported to cause coronary artery spasm and myocardial infarction in a 28 year-old man [101]. The patient took 30 mg pseudoephedrine for rhinitis and experienced chest pressure. The next night he took an additional 60 mg and had crushing chest pressure. An electrocardiogram showed ST-segment elevation consistent with a myocardial infarction, and cardiac enzymes were elevated. The pain and electrocardiographic changes resolved after administration of sublingual nitroglycerin.

Dermatologic Adverse Reactions

Brownstein reported two cases of fixed-type skin eruptions after use of Actifed®, a combination of pseudoephedrine with an antihistamine, triprolidine [102]. The rashes subsided within a few days after the medication was discontinued but reappeared after the patients again ingested Actifed. One of the two patients was challenged three times with 50-mg doses of pseudoephedrine. Each time, the rash recurred at the same sites. A fixed drug eruption was described in a 48-year-old woman on two occasions after administration of pseudoephedrine [103]. Indurated erythematous plaques developed on the right upper eyelid, elbows, antecubital fossae, axillae, and lower legs. The lesions were mildly pruritic. Discontinuance of pseudoephedrine and corticosteroid therapy resulted in clearing of the eruption on both occasions. Two similar cases of pseudoephedrine-induced fixed drug eruptions have been reported [104].

In multiple separate episodes over the course of 19 years, a man developed intense pruritus of the fingers about 12 hours after ingesting pseudoephedrine-containing products [105]. This was followed by severe redness, swelling, heat, and white papules on the fingers. The swelling subsided after 7 days and was followed by desquamation lasting about 2 weeks.

After ingesting medication containing triprolidine plus 60 mg pseudoephedrine, a 10-year old boy developed an oedematous, erythematous plaque [106]. The lesion cleared within 2 weeks and reappeared at the same site after rechallenge with 30 mg pseudoephedrine.

Pseudoephedrine was associated with pseudo-scarlatina in a 32-year-old woman [107]. The reaction recurred after rechallenge with pseudoephedrine.

Other Types of Adverse Reactions

Severe agitation, screaming, and confusion occurred in a 10-month-old infant with phenylketonuria after administration of pseudoephedrine 15 mg every 6 hours for treatment of acute otitis media. Symptoms were noted within 1 hour after the first dose and recurred after each dose for two subsequent doses. After discontinuation of pseudoephedrine, no further episodes occurred. The patient's plasma concentration of phenylalanine, which had previously ranged from 2 to 7 mg/dL, increased to 12 mg/dL during the illness [108].

An 18-year-old woman developed symptoms presenting as recurrent toxic shock syndrome after ingesting pseudoephedrine-containing cold preparations and after a challenge with 60 mg pseudoephedrine [109]. She remained symptom-free for 1 year, during which she avoided pseudoephedrine-containing medications. When she inadvertently used a cough syrup containing pseudoephedrine, she again developed toxic shock symptoms.

DRUG INTERACTIONS

Serious Drug Interactions

- With acetaminophen may increase the risk of adverse renal effect.
- With acetylsalicylic acid (ASA), other NSAIDs including ibuprofen may result in possible additive side effects (See *Contraindications*).
- With anticoagulants may increase the risk of GI adverse events (e.g., ulceration and bleeding).
- With antihypertensives the benefit and risk must be weighed individually.
- With digoxin may increase serum digoxin concentration and the risk of digoxin toxicity.
- With diuretics may reduce the diuretic effect.
- With hypoglycaemic agents (insulin and oral agents) may increase the risk of hypoglycaemia.
- With lithium may elevate plasma lithium levels, reduce renal lithium clearance and increase the risk of lithium toxicity.
- With methotrexate may increase the risk of methotrexate toxicity.
- With monoamine oxidase inhibitors may result in hypertensive crisis and other serious adverse reactions (See *Contraindications*).

Overview

Ibuprofen+Pseudoephedrine Caplets is not recommended for concomitant use with any other NSAIDs, including ASA and other ibuprofen. Documented or possible drug interactions with Ibuprofen+Pseudoephedrine Caplets include acetaminophen, digoxin, anticoagulants, oral antidiabetic agents and insulin, antihypertensives, diuretics, methotrexate, lithium, and other protein-bound drugs.

Drug-Drug Interactions

The drugs listed in this section are based on either drug interaction case reports or studies, or potential interactions due to the expected magnitude and seriousness of the interaction (*i.e.*, those identified as contraindicated).

Acetaminophen

Although interactions have not been reported, concurrent use with Ibuprofen+Pseudoephedrine Caplets is not advisable: it may increase the risk of adverse renal effect.

Acetylsalicylic acid (ASA) or other NSAIDs

The use of Ibuprofen+Pseudoephedrine Caplets in addition to any other NSAID, including ASA, is not recommended due to the possibility of additive side effects. Animal studies show that acetylsalicylic acid given with NSAIDs, including ibuprofen, yields a net decrease in anti-inflammatory activity with lowered blood levels of the non-acetylsalicylic acid drug. Single-dose bioavailability studies in normal volunteers have failed to show an effect of acetylsalicylic acid on ibuprofen blood levels. Correlative clinical studies have not been conducted (see *Contraindications*).

Antacids [82]

A bioavailability study has shown that there was no interference with the absorption of ibuprofen when

given in conjunction with an antacid containing aluminium hydroxide and magnesium hydroxide.

Anticoagulants [77,78]

Numerous studies have shown that the concomitant use of NSAIDs and anticoagulants increases the risk of GI adverse events such as ulceration and bleeding. Because prostaglandins play an important role in hemostasis, and NSAIDs affect platelet function, concurrent therapy of ibuprofen with warfarin requires close monitoring to be certain that no change in anticoagulant dosage is necessary. Several short-term controlled studies failed to show that ibuprofen significantly affected prothrombin time or a variety of other clotting factors when administered to individuals on coumarin-type anticoagulants. Nevertheless, the physician, should be cautious when administering Ibuprofen+Pseudoephedrin Caplets to patients on anticoagulants.

Antihypertensives

Prostaglandins are an important factor in cardiovascular homeostasis and inhibition of their synthesis by NSAIDs may interfere with circulatory control. NSAIDs may elevate blood pressure in patients receiving antihypertensive medication. Two meta analyses[157,158] have observed this relationship for NSAIDs as a class and for certain NSAIDs in particular, but ibuprofen did not significantly affect blood pressure in either meta analysis. Consistent with this lack of effect, a study by Davies et al[159] showed that ibuprofen 1600 mg/day for 14 days did not attenuate the antihypertensive effect of two β -adrenergic blockers. Houston et al.[160] showed no effect of three weeks' therapy with ibuprofen on the antihypertensive efficacy of verapamil, but it is not known whether this lack of interaction extends to other classes of calcium channel blockers.

When renal perfusion pressure is reduced both prostaglandins and angiotensin II are important mediators of renal autoregulation.[153] As a class, the combination of an NSAID and angiotensin converting enzyme inhibitor theoretically may have the potential to decrease renal function. One study found a clinically significant decrease in renal function in 4 of 17 patients treated with hydrochlorothiazide and fosinopril who received ibuprofen 2400 mg/day for one month.[154] In contrast, Minuz[155] found no effect on the antihypertensive effect of enalapril or on plasma renin or aldosterone following two days' treatment with ibuprofen 1200 mg/day.

The relationship of ibuprofen and antihypertensives is clearly not well defined. The benefits of concomitant medication should be analysed and compared to the potential risks before being prescribed. If ibuprofen is being recommended for long-term use, then periodic monitoring of blood pressure may be useful. Blood pressure monitoring is not necessary if ibuprofen is being recommended for short-term use as an analgesic.

Cough-cold/allergy Medications:

The use of other decongestants, cough and cold medications, allergy medications or medications containing pseudoephedrine or ibuprofen should be avoided as it can increase the risk of serious side effects and overdose.

Digoxin [156]

Ibuprofen has been shown to increase serum digoxin concentration. Increased monitoring and dosage adjustments of digitalis glycoside may be necessary during and following concurrent ibuprofen therapy.

Diuretics

Clinical studies, as well as random observations, have shown that ibuprofen can reduce the natriuretic effect of furosemide and thiazides in some patients. This response has been attributed to inhibition of renal prostaglandin synthesis. During concomitant therapy with ibuprofen, the patient should be observed closely for signs of renal failure as well as to assure diuretic efficacy.

H-2 antagonists

In studies with human volunteers, coadministration of cimetidine or ranitidine with ibuprofen had no substantive effect on ibuprofen serum concentrations.

Hypoglycaemic Agents

Ibuprofen may increase hypoglycaemic effects of oral antidiabetic agents and insulin.

Lithium[80]

Ibuprofen produced an elevation of plasma lithium levels and a reduction in renal lithium clearance in a study of eleven normal volunteers. The mean minimum lithium concentration increased 15% and the renal clearance of lithium was decreased by 19% during this period of concomitant drug administration. This effect has been attributed to inhibition of renal prostaglandin synthesis by ibuprofen. Thus, when ibuprofen and lithium are administered concurrently, subjects should be observed carefully for signs of lithium toxicity.

Methotrexate[79]

Ibuprofen as well as other NSAIDs has been reported to competitively inhibit methotrexate accumulation in rabbit kidney slices. This may indicate that ibuprofen could enhance the toxicity of methotrexate. Caution should be used when ibuprofen is administered concomitantly with methotrexate.

Monoamine Oxidase Inhibitors

Ibuprofen+Pseudoephedrine Caplets should not be used concomitantly with MAO inhibitors or for 14 days after stopping the MAOI drug. MAO inhibitors are prescribed for treatment of depression, psychiatric or emotional conditions, or Parkinson's disease. Hypertensive crisis and other serious adverse reactions have been reported in patients using pseudoephedrine or other sympathomimetic drugs such as ephedrine in combination with or shortly after discontinuing MAO inhibitors [141, 142] (See *Contraindications*).

Other Drugs

Ibuprofen+Pseudoephedrine Caplets should be used with caution when other drugs, also having a high affinity for protein binding sites, are used concurrently. However, while ibuprofen binds extensively to plasma proteins, interactions with other protein-bound drugs occur rarely. Caution should be used when taking Ibuprofen+Pseudoephedrine Caplets in conjunction with probenecid, thyroxine, cyclosporine, antibiotics (e.g. levofloxacin), phenytoin, corticosteroids or benzodiazepines.

Drug-Food Interactions

Interactions with food have not been established.

Drug-Herb Interactions

Interactions with herbal products have not been established.

Drug-Laboratory Interactions

Interactions with laboratory tests have not been established.

Drug-Lifestyle Interactions

Avoid drinking alcohol while taking Ibuprofen+Pseudoephedrine Caplets as this may increase the risk of serious stomach bleeding. Avoid smoking while taking Ibuprofen+Pseudoephedrine Caplets or other NSAIDs.

DOSAGE AND ADMINISTRATION

Dosing Considerations

Do not take for fever for more than 3 days or for more than 5 days for cold symptoms/pain.

Patients older than 65 years should not use Ibuprofen+Pseudoephedrine Caplets.

Recommended Dose and Dosage Adjustment

Adults under 65 years of age and children over 12 years of age: Take 1 or 2 caplets every 4 to 6 hours as needed. No more than 6 caplets are to be taken in 24 hours, unless directed by a physician.

Missed Dose

Take the missed dose as soon as you remember. If it is almost time for your next dose, wait until then to take your medicine and skip the missed dose. Do not take two doses at the same time.

Administration

See *Recommended Dose and Dosage Adjustment*

OVERDOSAGE

Symptoms of Overdosage:

Ibuprofen+Pseudoephedrine Caplets caplets contain ibuprofen and pseudoephedrine hydrochloride. The toxicity of overdose is dependent upon the amount of the product ingested and the time elapsed since ingestion; individual responses may vary, thus making it necessary to evaluate each case separately. The most frequently reported symptoms of the two combination drugs in situations of overdose include abdominal pain, nausea, vomiting, lethargy and drowsiness, headache, tinnitus, CNS depression, seizures, anxiety, hyperexcitability, irritability, delirium, convulsions, dilated pupils, tachycardia, bradycardia, hypertension or hypotension, atrial fibrillation, abnormal speech, visual and tactile hallucinations, ataxia, and hyper-reflexia. Metabolic acidosis, electrolyte disturbances, coma, acute renal failure, and apnoea (primarily in very young children) may rarely occur.

Treatment of Overdosage:

In cases of acute overdose, the stomach should be emptied through induction of emesis (in alert patients only) or gastric lavage. Due to the rapid absorption of pseudoephedrine and ibuprofen from the gut,

emesis is most effective if initiated within 30 minutes of ingestion. Orally administered activated charcoal may help in reducing the absorption of drugs when given less than 2 hours following ingestion. There is some evidence that repeated administration of activated charcoal may bind the medication that has diffused from the circulation [152]. Inducing diuresis may be helpful. The treatment of acute overdose is primarily supportive. Cardiac status should be monitored and the serum electrolytes measured. If there are signs of cardiac toxicity, propranolol may be administered intravenously. A slow infusion of a dilute solution of potassium chloride should be initiated in the event of a drop in the serum potassium level. Despite hypokalemia, the patient is unlikely to be potassium depleted; therefore, overload must be avoided. Monitoring of the serum potassium is advisable for several hours after administration of the salt. For delirium or convulsions, intravenous administration of diazepam is indicated.

Examples of Ibuprofen Overdose:

A 41-year-old man with multiple medical problems, including long-term renal insufficiency, developed near-fatal acute renal failure after ingestion of a massive dose (36 g) of ibuprofen [110]. He required dialysis for several months, at which point his renal function improved.

In children, ibuprofen overdoses less than 100 mg/kg are unlikely to produce toxicity. In adults, the dose of ibuprofen reportedly ingested does not appear to be predictive of toxicity.

With electrolyte replacement and other intensive measures, a 21-month-old child recovered within 5 days after accidental ingestion of 8 g of ibuprofen [111]. A 2-year-old child who ingested approximately 8 g of ibuprofen was treated with activated charcoal, developed metabolic acidosis and acute renal insufficiency, and recovered within 72 hours [112]. A 6-year-old child became comatose after ingesting 6 g of ibuprofen [113]. He was treated with gastric lavage, charcoal, and various supportive measures and recovered within 24 hours.

Examples of Pseudoephedrine Overdose

Hypertensive crisis (blood pressure 200/160 mmHg) was reported in a 23-year-old man after ingestion of 840 mg pseudoephedrine (in Trinalin® tablets; also containing azatadine). The patient presented with severe headache, dizziness, diaphoresis, and epigastric pain. His hypertension was treated effectively with intravenous labetalol [114].

In a study to determine the toxicity of pseudoephedrine in children 2 to 6 years of age, 22% of 101 exposures to doses ranging from 30 to 180 mg were associated with drowsiness, and 7% were associated with mild hyperactivity [115]. The symptoms were mild, and the children were treated with fluids and observation. Of 39 exposures to doses above 180 mg, 15% were associated with drowsiness and 13% were associated with mild hyperactivity.

Hypertension was reported in an 8-week-old infant after administration of pseudoephedrine 7.5 mg four times daily orally and phenylephrine 1/4% intranasally four times daily for 7 days. The infant's blood pressure normalized after discontinuation of the decongestants and remained normal at follow-up [116]. A 2-year-old boy was overdosed with a non-prescription cough and cold preparation containing 7.5 mg dextromethorphan and 15 mg pseudoephedrine per 5 mL [117]. After receiving three doses of 1.5 teaspoonfuls spaced 6 hours apart, he developed hyperexcitability, hyperirritability, agitation, incoherent babbling, and difficulty maintaining his balance. On examination, the patient exhibited hyperactivity, ataxia, dilated pupils, and tachycardia (180 beats per minute). His status normalized over a period of 4

hours.

A 3-year-old girl experienced visual hallucinations after administration of a nonprescription decongestant containing pseudoephedrine [118]. The child had inadvertently been given 20 mg/kg of pseudoephedrine administered in two doses over the previous 12 hours. A 5-year-old boy suffered from severe hallucinations beginning 5 hours after drinking 60 mL of a syrup containing pseudoephedrine and triprolidine (Actifed®) [119].

Pseudoephedrine overdose may precipitate psychosis in individuals with underlying psychiatric disorders.

A 27-year-old man with a history of bipolar affective disorders experienced an episode of acute paranoid psychosis after chronic abuse of Actifed® syrup (pseudoephedrine and triprolidine) [120]. The patient had abused Actifed® for several years, taking one to two bottles on weekends. Approximately 4 days prior to onset of visual and auditory hallucinations and paranoia, he had increased the amount to two bottles per day. His hallucinations disappeared within 1 day after discontinuation of Actifed®.

A mixed bipolar psychotic disorder was precipitated by a large dose of pseudoephedrine in a 13 year-old girl with a familial predisposition to psychotic disorders [121]. The patient took 8 tablets of 60 mg pseudoephedrine in one afternoon. She was hospitalized for psychiatric treatment and was discharged after 2 weeks. She had another psychotic episode 7 months later, without exposure to pseudoephedrine.

A 19-month-old girl who ingested approximately 600 mg of pseudoephedrine experienced a generalized tonic clonic seizure [122].

Examples of Ibuprofen/Pseudoephedrine Hydrochloride Combination Products Overdose

In seven of eight reports of overdose with an ibuprofen/pseudoephedrine hydrochloride combination, the patients recovered without hospitalisation. A 17-year-old woman ingested eight tablets of ibuprofen/pseudoephedrine hydrochloride combination plus 24 to 30 tablets of extra-strength Tylenol. She was treated with Mucomyst and charcoal and was discharged from the hospital after a 2-day stay [124].

In pediatric patients, the estimated amount of ibuprofen ingested per body weight may be helpful to predict the potential for development of toxicity although each case must be evaluated. Ingestion of less than 100 mg/kg is unlikely to produce toxicity. Pediatric patients ingesting 100 to 200 mg/kg may be managed with induced emesis and a minimal observation time of at least four hours. Pediatric patients ingesting 200 to 400 mg/kg of ibuprofen should have immediate gastric emptying and at least four hours observation. Pediatric patients ingesting greater than 400 mg/kg require immediate medical referral, careful observation and appropriate supportive therapy. Induced emesis is not recommended in overdoses greater than 400 mg/kg because of the risk for convulsions and the potential for aspiration of gastric contents.

In adult patients, the dose reportedly ingested does not appear to be predictive of toxicity. The need for referral and follow-up must be judged by the circumstances at the time of the overdose ingestion. Symptomatic adults should be carefully evaluated, observed and supported.

ACTION AND CLINICAL PHARMACOLOGY

Mechanism of Action

Ibuprofen:

Like other nonsteroidal anti-inflammatory drugs (NSAIDs), ibuprofen is an analgesic, antipyretic, and anti-inflammatory medication [1]. The principal mechanism of action of ibuprofen and other NSAIDs is inhibition of prostaglandin biosynthesis [2,3]. Prostaglandins contribute to fever, pain, and inflammation by sensitizing tissues to pain- and inflammation-producing mediators such as histamine, 5-hydroxytryptamine, and kinins. The committed step in prostaglandin biosynthesis is catalyzed by prostaglandin endoperoxide synthase, also known as cyclooxygenase [4]. NSAIDs decrease prostaglandin biosynthesis by inhibiting cyclooxygenase.

A recent study confirmed that ibuprofen 400 mg provided a significantly faster onset of relief as measured by first perceptible relief, meaningful relief, per cent attaining complete relief, and superior overall analgesic efficacy compared to acetaminophen 1000 mg for relief of episodic tension-type headache[151].

Pseudoephedrine Hydrochloride

Pseudoephedrine acts directly on both alpha- and, to a lesser degree, beta-adrenergic receptors [16]. It is believed that alpha-adrenergic effects result from inhibition of the production of cyclic adenosine-3',5'-monophosphate (AMP) by inhibition of the enzyme adenylyl cyclase, whereas beta-adrenergic effects result from stimulation of adenylyl cyclase activity. Like ephedrine, pseudoephedrine also acts indirectly by releasing norepinephrine from its storage sites [16].

Pseudoephedrine acts directly on alpha-adrenergic receptors in the mucosa of the respiratory tract, producing vasoconstriction that results in shrinkage of swollen nasal mucous membranes, reduction of tissue hyperaemia, oedema, and nasal congestion, and, thereby, an increase in nasal airway patency [16]. Drainage of sinus secretions is increased, and obstructed eustachian ostia may be opened [16].

Pharmacokinetics

Absorption:

Ibuprofen

Ibuprofen is a racemic mixture of R(-) ibuprofen and S(+) ibuprofen. R(-) ibuprofen undergoes extensive (53% to 65%) enantiomeric conversion to S(+) ibuprofen in humans [5]. S(+) ibuprofen is the pharmacologically active enantiomer.

Ibuprofen is rapidly absorbed after oral administration. Serum concentrations reach a peak within 1 to 2 hours in adults [4] and in children [6,7,8]. Food decreases the rate but not the extent of ibuprofen absorption [4].

Pseudoephedrine Hydrochloride

After oral administration, pseudoephedrine is readily and completely absorbed from the gastrointestinal tract, with no evidence of first-pass metabolism [16,17]. After oral administration of syrups containing 60 mg or 120 mg of pseudoephedrine, peak plasma pseudoephedrine concentrations of 180 ng/mL to

422 ng/mL, respectively, were obtained at 1 to 2 hours [18,19,20,21].

In a study of five children aged 6 to 12 years receiving 2 mg/kg of pseudoephedrine up to a maximum dose of 60 mg, the peak concentration (C_{max}) was 338 ng/mL, T_{max} was 1.86 hours, and t_{1/2} was 4.61 hours [22]. More recently, Simons et al characterized the pharmacokinetics of pseudoephedrine in children with seasonal allergic rhinitis [23]. The results are presented in Table 2.

Table 2 Pharmacokinetics of Pseudoephedrine in Children with Seasonal Allergic Rhinitis (Mean Age, 8.8 Years)

Pharmacokinetic Parameter	Pseudoephedrine 30 mg (N = 7)	Pseudoephedrine 60 mg (N = 7)
C _{max} (ng/mL)	244± 21	492±72
T _{MAX} (H)	2.1±0.3	2.4±0.2
t _{1/2} (h)	3.1±0.5	3.1±0.4
AUC (ng/mL/h)	1260±126	2414±336
Cl (mL/min/kg)	10.3±1.2	9.2±0.7
V _{dss} (L/kg)	2.6±0.3	2.4±0.4

Note: Values are means ± standard error of the mean (SEM). AUC = area under the plasma concentration versus time curve, Cl = clearance, V_{dss} = steady-state volume of distribution.

In a study conducted in 25 children 6 to 11 years of age, the absorption of pseudoephedrine from an ibuprofen 200 mg/pseudoephedrine 30 mg tablets was found to be equivalent to the absorption of pseudoephedrine from a pseudoephedrine 30 mg tablet (Table 3) [24].

Table 3 Pharmacokinetics of 30 mg Pseudoephedrine Administered Alone or with 200 mg Ibuprofen in 25 Children

Treatment	AUC _L (ng•h/mL)	AUC _I (ng•h/mL)	C _{max} (ng/mL)	T _{max} (h)	t _½ (h)
Ibuprofen 200mg/pseudoephedrine 30mg tablets Tablet	1565.7 (530.5)	1859.0 (611.3)	265.8 (86.8)	2.2 (1.0)	4.6 (1.0)
Pseudoephedrine 30mg tablet	1510.5 (561.1)	1791.9 (526.2)	236.0 (72.5)	2.3 (0.9)	4.7 (0.6)

Note: Values are means (SEM). AUC_L = AUC to last measurable concentration, AUC_I = AUC extrapolated to infinity.

The absorption rate of pseudoephedrine, as measured by its urinary excretion rate, is significantly increased by the concurrent administration of aluminium hydroxide gel, is decreased by kaolin, and is unaffected by sodium bicarbonate [25]. Food appeared to delay absorption of pseudoephedrine from syrup formulations and controlled-release capsules but had no effect on absorption from a suspension [19, 21].

Distribution:

Ibuprofen

After oral administration, the volume of distribution of ibuprofen was 0.1–0.2 L/kg in adults [9] and

0.18–0.22 L/kg in febrile children [6]. At therapeutic concentrations, ibuprofen is extensively bound to whole human plasma and binds primarily to site II of purified albumin [9].

Pseudoephedrine Hydrochloride

The volume of distribution of pseudoephedrine ranged from 2.64 L/kg to 3.51 L/kg in single- and multiple-dose studies [26,27]. Pseudoephedrine concentration-time data after oral administration are well described using a one body compartment model with first-order absorption and elimination [26,27]. The approximate plasma clearance of pseudoephedrine is 0.44 L/h/kg [26].

Metabolism:

Ibuprofen

The plasma half-life ($t_{1/2}$) of ibuprofen in adults and children is 1.5–2.0 hours [6,10]. There is no appreciable plasma accumulation of ibuprofen or its metabolites with repeated doses [4]. Two major metabolites, 2-[4-(2-carboxypropyl)phenyl] propionic acid and 2-[4-(2-hydroxy-2-methylpropyl)propionic acid, have been identified in plasma and in urine [11,12]. Parent drug and metabolites are excreted primarily in the urine. Bile and faeces are relatively minor elimination routes. Approximately 80% of an ibuprofen dose is recovered in urine within 24 hours, primarily as carboxymetabolites and hydroxymetabolites, both conjugated and unconjugated [9].

Cytochrome P450 (CYP) 2C9 has been identified as the most important enzyme in the oxidative metabolism of R-(-) and S-(+) ibuprofen [13]. Ibuprofen does not appear to induce the formation of drug-metabolizing enzymes in rats [12].

There is no evidence of changes in metabolism or elimination of ibuprofen with advanced age. A pharmacokinetic evaluation of ibuprofen in subjects 65 to 78 years of age compared with young adult subjects (22 to 35 years of age) found no clinically significant difference in the pharmacokinetic profiles of ibuprofen for the two age groups [14]. Furthermore, there was no statistically significant difference between the two age groups in the urinary excretion pattern of the drug and its major metabolites. The pharmacokinetic results for ibuprofen in children are similar to findings in adults.

Pseudoephedrine Hydrochloride

Less than 1% of pseudoephedrine is eliminated by hepatic metabolism. The major biotransformation of pseudoephedrine is N-demethylation to the active metabolite norpseudoephedrine [17].

Because pseudoephedrine is a weak base, with a pKa of 9.2, its half-life is dependent on urinary pH. The serum half-life increases as urine pH increases, varying from 1.9 hours at pH 5.6 to 21 hours at pH 7.8 [33,34]. At urine pH greater than 7.0, pseudoephedrine is extensively reabsorbed in the renal tubules, and therefore its excretion rate is dependent on urine flow rate. Higher flow rates decrease the intratubular drug concentration and the time for reabsorption, leading to greater renal clearance. When urine pH is acidic, renal reabsorption is negligible and urine flow does not influence clearance of the drug.

In a study in children in which the urine pH was 6.5, pseudoephedrine had a shorter half-life (3.1 hours) and faster clearance (9.2 to 10.3 mL/min/kg) than in studies of similar design in adults in which the urine pH was not controlled or reported [23]. Fifty-six percent of the pseudoephedrine dose was

recovered in the urine within 12 hours, and an additional 10% was recovered over the period from 12 to 24 hours.

The shorter terminal elimination half-life of pseudoephedrine in children may reflect greater renal tubular secretion or reabsorption in children than in adults. The faster clearance rate and smaller volume of distribution in children than in adults is probably due to the relatively lower lean body mass in children [23]. Over the 30-mg to 60-mg dose range, the kinetics of pseudoephedrine in children were not dose dependent [35].

Excretion:

Ibuprofen

Ibuprofen is rapidly excreted in breast milk. Thirty minutes after oral ingestion of 400 mg of ibuprofen, the concentration in breast milk was found to be 13 ng/mL [15]. The milk: plasma ratio was 1:126, and the exposure of a suckling infant to ibuprofen was calculated to be approximately 0.0008% of the maternal dose [15]. Studies in animals indicate that ibuprofen is transported across the placenta.

Pseudoephedrine Hydrochloride

Pseudoephedrine is excreted largely unchanged in urine, with 43% to 96% recovered in 24 hours [25,28,28,29,30,31,32]. Norpseudoephedrine recovery from urine ranged from less than 1% to 6.2% [28,21,33].

Pseudoephedrine is presumed to cross the placenta and to enter the cerebrospinal fluid [36]. Approximately 0.4% to 0.7% of an oral dose is excreted in breast milk over 24 hours [37]. Pseudoephedrine levels two to three times higher in milk than in plasma have been reported [37]. Adverse effects (irritability, excessive crying, disturbed sleeping patterns) were reported in a breast-fed infant whose mother had received pseudoephedrine [38]. The symptoms resolved within 12 hours after discontinuation of pseudoephedrine.

STORAGE AND STABILITY

Ibuprofen+Pseudoephedrine Caplets should be stored in tightly closed containers at room temperature (15°C -30°C).

Others:

Keep in a safe place out of the reach of children.

SPECIAL HANDLING INSTRUCTION

Not applicable.

DOSAGE FORMS, COMPOSITION AND PACKAGING

Ibuprofen+Pseudoephedrine Caplets is available as brown coloured, oval, biconvex film-coated caplets

having '271' debossing on one side and plain surface on the other side, containing 200 mg ibuprofen and 30 mg pseudoephedrine hydrochloride. Ibuprofen+Pseudoephedrine Caplets are available in bottles of 24's and 100's and in blister packs of 10's.

Ibuprofen+Pseudoephedrine Caplets contain the following nonmedicinal ingredients: Pregelatinized starch, Microcrystalline cellulose, Povidone, Stearic acid, Sodium Lauryl Sulphate, Croscarmellose Sodium, Colloidal Silicon Dioxide and Opadry AMB Brown (contains polyvinyl alcohol, titanium dioxide, talc, yellow iron oxide, iron oxide red, lecithin, xanthan gum).

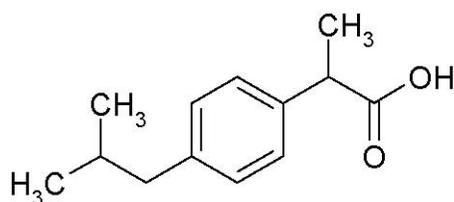
PART II: SCIENTIFIC INFORMATION

PHARMACEUTICAL INFORMATION

Ibuprofen:

Proper name:	Ibuprofen
Chemical name:	α -methyl-4-(2-methylpropyl) benzeneacetic acid (\pm)
Other names:	(\pm) p-isobutylhydratropic acid (\pm) 2-(4-isobutylphenyl)-propionic acid
Molecular formula and molecular mass:	C ₁₃ H ₁₈ O ₂ ; 206.28 g/mol

Structural Formula:



Physicochemical properties:

Physical characteristics:	White or almost white powder or crystals with a characteristic odour
Solubility:	Low solubility in water (<0.1 mg/mL), soluble 1 in 1.5 of alcohol, 1 in 1 of chloroform, 1 in 2 of ether, and 1 in 1.5 of acetone. Ibuprofen is also soluble in an aqueous solution of alkali hydroxides and carbonates.
pKa value:	pKa = 4.43
Melting Point:	75–77°C

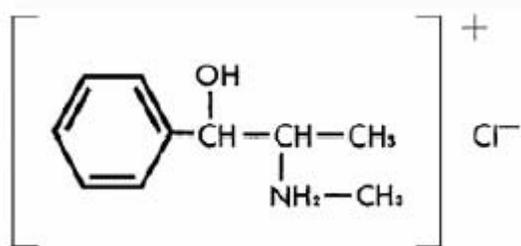
Pseudoephedrine Hydrochloride:

Proper name: Pseudoephedrine hydrochloride

Chemical name: S-(R*, R*)- α -{1-(methylamino)ethyl}benzenemethanol hydrochloride

Other names: (+)-Pseudoephedrine hydrochloride

Structural Formula:



Molecular formula and molecular mass: C₁₀H₁₅NOHCl; 201.70 g/mol

Physicochemical properties:

Physical characteristics:	White powder or crystals
Solubility:	Soluble in water, alcohol, and chloroform
pKa and pH values:	pKa = 9.2, pH = 5.9 in an aqueous solution of 1 in 200
Melting Point:	182–186°C

CLINICAL TRIALS

Comparative Bioavailability Studies

A randomized, open label, single dose, two way crossover, bioequivalence study was conducted with 24 healthy adult Asian human male subjects under fasting conditions comparing Ibuprofen+Pseudoephedrine Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride)

to Advil Cold and Sinus Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride) (Wyeth Consumer Healthcare Inc.).

SUMMARY TABLE OF COMPARATIVE BIOAVAILABILITY DATA IBUPROFEN

Ibuprofen (1 x 200/30mg ibuprofen/pseudoephedrine hydrochloride caplet) From measured data Geometric Mean Arithmetic Mean (CV %)				
Parameter	Test*	Reference†	% Ratio of Geometric Means	90% Confidence Interval
AUC _T (µg.h/mL)	46.14 48.88 (34.77)	46.45 48.71 (30.05)	99.33	93.86 – 105.11
AUC _∞ (µg.h/mL)	48.46 51.13 (33.92)	48.95 51.02 (28.70)	98.98	93.64 – 104.62
C _{max} (µg/mL)	15.07 15.62 (28.52)	14.58 15.01 (22.84)	103.35	93.22 – 114.59
T _{max} § (h)	2.05 (48.34)	2.13 (44.70)		
T _{1/2} § (h)	1.89 (20.06)	1.91 (20.31)		

*Ibuprofen+Pseudoephedrine Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride) (Marcan Pharmaceuticals Inc.)

† Advil Cold & Sinus Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride) (Wyeth Consumer Healthcare Inc.) were purchased in Canada.

§ Expressed as the arithmetic mean (CV%) only.

**SUMMARY TABLE OF COMPARATIVE BIOAVAILABILITY DATA PSEUDOEPHEDRINE
HYDROCHLORIDE**

Pseudoephedrine (1 x 200/30mg ibuprofen/pseudoephedrine hydrochloride caplet) From measured data Geometric Mean Arithmetic Mean (CV %)				
Parameter	Test*	Reference [†]	% Ratio of Geometric Means	90% Confidence Interval
AUC _T (µg.h/mL)	12.55 12.84 (22.40)	13.65 14.05 (25.88)	91.98	87.89 – 96.26
AUC _∞ (µg.h/mL)	12.97 13.26 (21.96)	14.25 14.72 (27.97)	91.04	86.67 – 95.64
C _{max} (µg/mL)	1.72 1.78 (27.14)	1.68 1.74 (27.27)	102.53	96.47 – 108.96
T _{max} [§] (h)	1.68 (39.68)	1.94 (44.25)		
T _{1/2} [§] (h)	4.21 (14.82)	4.58 (23.52)		

*Ibuprofen+Pseudoephedrine Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride) (Marcan Pharmaceuticals Inc.)

[†] Advil Cold & Sinus Caplets (200 mg ibuprofen/30 mg pseudoephedrine hydrochloride) (Wyeth Consumer Healthcare Inc.) were purchased in Canada.

§ Expressed as the arithmetic mean (CV%) only.

Study Results

Published studies have documented the efficacy of 200-mg and 400-mg doses of ibuprofen in treating mild to moderate pain, including sore throat pain [39], headache [40,41], and muscle aches [42] in adults. The antipyretic efficacy of ibuprofen has been demonstrated in adults at doses of 200 and 400 mg [43,44,45] and in children at doses of 5 to 10 mg/kg [46,47,48,49,50,51,52]. Ibuprofen is effective in treating the pain of sore throat in children [53,54,55].

A randomized, double-blind, placebo-controlled study in 179 subjects with nasal congestion secondary to upper respiratory tract infection showed a statistically significant increase in total nasal airflow 2 hours after single oral doses of pseudoephedrine 60 mg or ibuprofen 400 mg plus pseudoephedrine 60 mg [56]. Time-weighted sums of changes in nasal airflow relative to baseline were greater with both active treatments than with placebo (Table 4).

Table 4 Mean Nasal Air Flow (Standard Deviation) after Single Doses of Pseudoephedrine 60 mg or Ibuprofen 400 mg plus Pseudoephedrine 60 mg in Subjects with Upper Respiratory Infection

Treatment	N	Mean Nasal Air Flow Rate (mL/sec)		P value versus Placebo ^a	
		First 4 Hours Postdose	Entire 6-Hour Period Postdose	First 4 Hours Postdose	Entire 6-Hour Period Postdose
Placebo	58	106 (362)	194 (569)		
Pseudoephedrine 60 mg	61	247 (387)	406 (580)	0.068	0.061
Ibuprofen 400 mg + Pseudoephedrine 60 mg	60	266 (481)	412 (639)	0.015	0.021

^a Pairwise comparisons. Additional pairwise comparisons showed no significant differences between the two active treatments ($p=0.524$ for the first 4 hours postdose, 0.653 for the entire 6-hour period postdose).

Pseudoephedrine at a dose of 60 mg increases maximal nasal inspiratory flow rate [57] and produces objective improvement in nasal airway resistance [58]. A single 60-mg oral dose of pseudoephedrine produced marked nasal decongestant effects within 30 minutes of administration, lasting for at least 4 hours [59]. In 40 subjects with nasal congestion associated with the common cold, two 60-mg doses of pseudoephedrine 4 hours apart produced no significant difference in maximum unilateral nasal airflow or total nasal air flow over a 7-hour period; however, minimum unilateral nasal air flow was significantly increased [60]. A single 60-mg dose of pseudoephedrine administered to subjects with nasal congestion due to the common cold significantly increased total nasal minimum cross-sectional area and nasal volume measured by acoustic rhinometry [61]. There was no significant change in nasal area as measured by active posterior rhinomanometry [61].

In a double-blind, randomized study [62], the decongestant activity of pseudoephedrine was dose related over the range of 30 to 60 mg, as measured by total nasal air flow (sum of left and right nares) in 112 subjects with nasal congestion associated with allergic rhinitis (Figure 1). At most time points postdose, the decongestant effect of the combination of ibuprofen 200 mg plus pseudoephedrine 30 mg was midway between that seen for pseudoephedrine 45 mg and 60 mg and greater than the decongestant effect of pseudoephedrine 30 mg (Table 5).

Figure 1 Mean Change in Nasal Air Flow after Single Oral Doses of Pseudoephedrine in Subjects with Allergic Rhinitis [62]

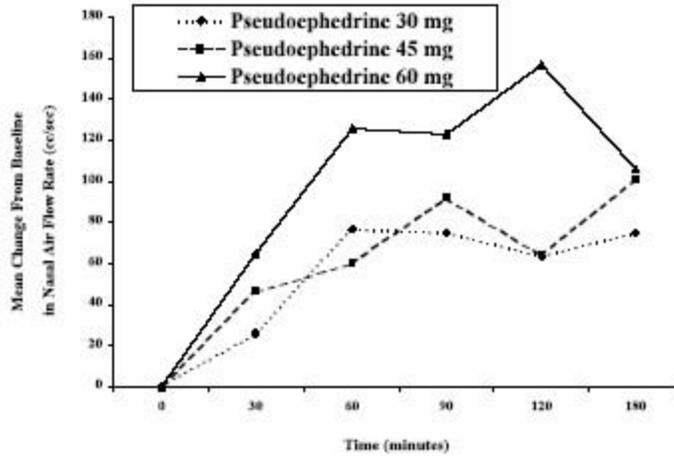


Table 5 Mean Nasal Air Flow (Standard Deviation) after Single Doses of Pseudoephedrine (30, 45, or 60 mg) or Ibuprofen 200 mg plus Pseudoephedrine 30 mg in Subjects with Allergic Rhinitis

Treatment	N	Mean Nasal Air Flow (mL/sec) at Specified Time Postdose, in Minutes						
		-30 Min	0 Min	30 Min	60 Min	90 Min	120 Min	180 Min
Pseudoephedrine								
30 mg	28	440 (185)	365 (101)	394 (152)	442 (174)	440 (173)	429 (158)	440 (155)
45 mg	28	406 (153)	356 (134)	401 (138)	416 (146)	450 (169)	423 (159)	457 (182)
60 mg	28	422 (143)	328 (119)	393 (157)	454 (217)	451 (196)	485 (214)	435 (136)
Ibuprofen 200 mg + pseudoephedrine 30 mg	28	416 (147)	365 (143)	416 (196)	454 (173)	429 (154)	468 (177)	477 (201)

Note: Time 0 = time of administration of study medication. Min = minutes.

DETAILED PHARMACOLOGY

Ibuprofen

Animal Pharmacology:

Cyclooxygenase inhibitors such as ibuprofen and other NSAIDs reduce thromboxane A2 production and release, thereby decreasing platelet aggregation [124]. Like many other NSAIDs, ibuprofen inhibits platelet aggregation, as demonstrated in vivo by prevention of platelet disposition in aortopulmonary arterial bypass grafts in dogs [125]. The drug’s protective action against pulmonary embolism in rabbits injected intravenously with arachidonic acid may also relate to inhibition of platelet aggregation

[126,127]. The decreased platelet aggregation may be due in part to a reduction in membrane fluidity [128].

The penetration of ibuprofen into rabbit and rat fetuses was investigated. Rabbits and rats in late pregnancy were given single oral doses of 60 and 20 mg/kg respectively of C14-labeled ibuprofen [11]. Rabbits were killed 3 hours after dosing, and rats were killed 1.5 hours after dosing. Blood samples were collected from the mothers and fetuses. The concentrations of radioactively labelled material were similar in maternal and foetal blood, indicating that ibuprofen and its metabolites readily crossed the placenta and entered the foetal circulation.

In healthy volunteers, platelet aggregation decreased significantly at a dosage of 1800 mg per day of ibuprofen given over a period of 28 days. Ibuprofen influenced ADP-induced aggregation to a lesser extent than collagen-induced aggregation. Platelet aggregation induced by recalcification of citrated platelet-rich plasma (a thrombin-induced reaction) was not influenced by ibuprofen treatment. Likewise, ibuprofen did not affect whole blood clotting time on recalcification or prothrombin time. Bleeding time measured 2 hours after administration of ibuprofen showed a significant, dose-related increase.

Pseudoephedrine Hydrochloride

Animal Pharmacology:

In dogs, pseudoephedrine acts as a vasopressor and vasoconstrictor with positive inotropic and chronotropic effects. In all these effects, pseudoephedrine is less potent than ephedrine [129]. The bronchodilating potencies of pseudoephedrine and ephedrine in anaesthetized dogs are approximately equal [130], but pseudoephedrine produces a greater degree of nasal decongestion with less cardiovascular involvement than ephedrine [131]. Pseudoephedrine increases plasma corticosterone levels and produces hyperglycemia in mice [132].

Human Pharmacology:

Pseudoephedrine at doses up to 180 mg is approximately one-fourth as potent as ephedrine in producing tachycardia and increased systolic blood pressure; diastolic pressure is unchanged [133]. After a single dose of pseudoephedrine 180 mg immediate release, three divided doses of 60 mg, or a sustained-release 180-mg dose, increases in heart rate and diastolic blood pressure were noted [29]. At doses from 60 mg to 240 mg, few changes in pulse rate were noted, and no abnormalities or ectopic beats were noted on an electrocardiogram; at 210 mg, changes in diastolic blood pressure were noted [134].

Single pseudoephedrine doses of 180 mg produced minor elevations in systolic blood pressure (about 7 mmHg), minor increases in heart rate (about 9 beats per minute), and no changes in diastolic blood pressure in healthy subjects [135]. Single doses of 60 mg had minimal effects.

Clinical studies of the cardiovascular effects of pseudoephedrine in subjects with controlled hypertension have produced differing results. A single 60-mg dose of pseudoephedrine compared with placebo produced significant increases in mean systolic blood pressure and heart rate in 20 hypertensive subjects [136]. Mean diastolic blood pressure and mean arterial pressure also increased, but not significantly. Beck et al found minimal increases in blood pressure and heart rate in patients with medically controlled hypertension treated with 120 mg sustained-release pseudoephedrine twice daily [137]. In other studies, pseudoephedrine at standard doses had no significant effect on systolic or

diastolic blood pressure [138,139]. In subjects with phaeochromocytoma, pseudoephedrine increased blood pressure and plasma noradrenaline concentration [140].

In children 6 to 12 years of age given 30-mg and 60-mg doses of pseudoephedrine in a pharmacokinetic study, pulse rate increased significantly at 4 hours postdose, particularly after the 60 mg dose [23, 35]. No clinically important adverse effects on blood pressure or on the central nervous system were noted.

A dose-related increase in frequency of sinus arrhythmias was observed after treadmill exercise in healthy subjects receiving pseudoephedrine [141]. The mean number of episodes of arrhythmia during recovery from exercise was 0.17, 2.17, and 4.33 in subjects pretreated with placebo, pseudoephedrine 60 mg, and pseudoephedrine 120 mg, respectively. Short-lived unifocal premature ventricular contractions were experienced by two subjects.

In an investigation of the effects on pseudoephedrine on uterine and foetal blood flow, 12 healthy, pregnant women between 26 and 40 weeks of gestation ingested a 60-mg dose of pseudoephedrine [142]. Doppler blood flow measurements taken during the first 3 hours after drug ingestion showed no significant alterations in maternal or foetal circulation.

Pseudoephedrine at a dose of 180 mg was reported to produce no significant mood alterations or changes in subjective ratings of mental state [29, 134]. In a study of the effects of pseudoephedrine on day- and night time central nervous system activity, there was no evidence of impairment of daytime activity as measured by objective tests (critical flicker fusion, choice reaction time, simulated car tracking test, and Sternberg Memory Scanning Test) or subjective tests (analog rating scales) [143]. Improvements were seen in psychomotor function (choice reaction time) and information processing (critical flicker fusion). Detrimental effects on night time central nervous system activity indicative of sleep disturbances (electroencephalogram, Leeds Sleep Evaluation Questionnaire) were noted with pseudoephedrine at doses of 60 mg and 120 mg [144].

Pseudoephedrine administered as a single 60-mg dose [142, 144] or 120-mg dose [142,145] or administered at 1–2 mg/kg [146] had no significant effect on exercise performance. Pseudoephedrine at doses of 60 mg and 120 mg had no effect on the time required to reach 85% maximal predicted heart rate on a treadmill or to return to baseline heart rate; on blood pressure at rest, during exercise, or in the recovery period; or on postexercise blood glucose and insulin levels [142].

The effect of pseudoephedrine as a bronchodilator is small at a 210-mg dose and is approximately one-half that of ephedrine [135]. In a study of subjects with reversible airway obstruction, pseudoephedrine at 60 mg and 180 mg produced no significant bronchodilation [147].

MICROBIOLOGY

Not applicable

TOXICOLOGY

Ibuprofen:

Single-dose toxicity studies have been conducted in mice, rats, and dogs [11]. The LD50 values for ibuprofen in mice and rats, expressed as mg/kg of body weight, are as follows:

Mice	Oral	800 mg/kg
	Intraperitoneal	320 mg/kg
Rats	Oral	1600 mg/kg
	Subcutaneous	1300 mg/kg

Acute signs of poisoning were prostration in mice and sedation, prostration, loss of righting reflex, and laboured respiration in rats. Death occurred within 3 days from perforated gastric ulcers in mice and intestinal ulceration in rats, irrespective of the route of administration. Single ibuprofen doses of 125 mg/kg and above in dogs caused emesis, transient albuminuria, faecal blood loss, and erosions in the gastric antrum and pylorus. No ill effects were seen with doses of 20 or 50 mg/kg.

The primary toxic effect of ibuprofen in repeated doses in rats is intestinal damage [11]. At a dosage of 180 mg/kg/day for 26 weeks, ibuprofen alters the organ-to-body weight ratio of certain organs, such as the liver, kidneys, gonads, and secondary sex organs, although no histological abnormalities have been observed and the effects are reversible. The liver and kidney enlargement may be a reflection of work hypertrophy associated with the metabolism and excretion of the compound, whereas the significance of the effects on other organs is unknown. When administered in lethal doses (540 mg/kg/day), ibuprofen produces mild kidney lesions in addition to intestinal damage.

In rats given 180 mg/kg/day of ibuprofen orally for 55 weeks and 60 mg/kg/day for the next 60 weeks, the only specific pathological effect observed was intestinal ulceration [148]. There was no evidence of tumour induction, indicating that ibuprofen is not carcinogenic in rats. Ibuprofen is not teratogenic when given in toxic doses (60 mg/kg/day) to rabbits or in ulcerogenic doses (180 mg/kg/day to rats [11].

Pseudoephedrine Hydrochloride

Mice injected with toxic doses of pseudoephedrine manifest increased motor activity, piloerection, and mydriasis, and they eventually die in respiratory exhaustion. The intravenous LD50 in mice is approximately 90 mg/kg [130]. The approximate oral LD50 values are 726 mg/kg (mice), 2206 mg/kg (rats), 1117 mg/kg (rabbits), 105 mg/kg (beagle dogs), and 307 mg/kg (mongrel dogs). Toxic effects of pseudoephedrine include increased respiratory activity, salivation, and lacrimation; loss of pupillary reflex in reaction to light; tremor, convulsions, and cardiac arrhythmias [149].

The LD50 values for pseudoephedrine, expressed as mg/kg of body weight, are as follows:

Mice	Oral	726
	Intravenous	90
Rats	Oral	2206
Rabbits	Oral	1117
Dogs, beagle	Oral	105
Dogs, mongrel	Oral	307

REFERENCES

1. Insel, PA. Analgesic-antipyretic and anti-inflammatory agents and drugs employed in the treatment of gout. In Molinoff PB, Ruddon RW, editors. *Goodman & Gilman's The Pharmacological Basis of Therapeutics*. New York: McGraw-Hill, 1996: 617-657.
2. Nozu K: Flurbiprofen: Highly potent inhibitor of prostaglandin synthesis. *Biochim Biophys Acta* 1978; 529: 493-496.
3. Moncada S, Vane JR: Mode of action of aspirin-like drugs. *Intern Med* 1979; 24: 1-22.
4. Adams SS, Buckler JW: Ibuprofen and flurbiprofen. *Clinics Rheum Dis* 1979; 5: 359-379.
5. Rudy AC, Knight PM, Brater DG, Hall SD: Enantioselective disposition of ibuprofen in elderly persons with and without renal impairment. *J Pharmacol Exp Ther* 1995; 273: 88-93.
6. Brown RD, Wilson JT, Kearns GL, Eichler VF, Johnson VA, Bertrand KM: Single-dose pharmacokinetics of ibuprofen and acetaminophen in febrile children. *J Clin Pharmacol* 1992; 32: 231-241.
7. Nahata MC, Durrell DE, Powell DA, Gupta N: Pharmacokinetics of ibuprofen in febrile children. *Eur J Clin Pharmacol* 1991; 40: 427-428.
8. Walson PD, Galletta G, Braden NF, Alexander L. Ibuprofen, acetaminophen, and placebo treatment of febrile children. *Clin Pharmacol Ther* 1989;46:9-17.
9. Davies NM: Clinical pharmacokinetics of ibuprofen. The first 30 years. *Clin Pharmacokinet* 1998;34:101-154.
10. Dollery C: Ibuprofen. In *Therapeutic Drugs*, 1st ed, Churchill Livingstone, 11-14. 1991.
11. Adams SS, Bough RG, Cliffe EE, Lessel B, Mills RFN: Absorption, distribution and toxicity of ibuprofen. *Toxicol Appl Pharmacol* 1969;15:310-330.
12. Mills RFN, Adams SS, Cliffe EE, et al: The metabolism of ibuprofen. *Xenobiotica* 1973; 3(9):589.
13. Leeman TD, Tanson C, Bonnabry C, Dayer P: A major role for cytochrome P450_{2C} (CYP2C subfamily) in the actions of non-steroidal anti-inflammatory drugs. *Drugs Exp Clin Res* 1993; 19: 189-195.
14. Albert KS, Gillespie WR, Wagner JG, Pau A, Lockwood GF: Effects of age on the clinical pharmacokinetics of ibuprofen. *Am J Med* 1984; 77: 47-50.
15. Walter K, Dilger C: Ibuprofen in human milk. *Br J Pharmacol* 1997; 44: 211-212.
16. Sympathomimetic (Adrenergic) Agents. In McEvoy GK, editor. Bethesda, Maryland: American Society of Health-System Pharmacists, American Hospital Formulary Service Drug Information, 1999: 1088-1156.
17. Kanfer I, Dowse R, Vuma V. Pharmacokinetics of oral decongestants. *Pharmacotherapy* 1993;13:116S-128S.
18. Graves DA, Rotenberg KS, Woodworth JR, Amsel LP, Hinsvark ON. Bioavailability assessment of a new liquid controlled-release pseudoephedrine product. *Clin Pharm* 1985;4:199-203.
19. Graves DA, Wecker MT, Meyer MC, Straughn AB, Amsel LP, Hinsvark ON, Bhargana AK, Rotenberg KS. Influence of a standard meal on the absorption of controlled-release pseudoephedrine suspension. *Biopharm Drug Dispos* 1988;9:267-272.
20. Graves DA, Woodworth JR, Hinsvark ON, Rotenberg KS. Single- and multiple-dose

- bioavailability studies for a controlled-release pseudoephedrine capsule formulation. *Curr Ther Res* 1988;43:630-635.
21. Wecker MT, Graves DA, Amsel LP, Hinsvark ON, Rotenburg KS. Influence of a standard meal on the absorption of controlled-release pseudoephedrine capsules. *J Pharm Sci* 1987;76:29-31.
 22. Autritt WA, Saccar CL, Handfinger MG, Mansmann HC, Yaffe SJ, Warren JT, Welch RM, Findlay JWA. Pharmacokinetics of pseudoephedrine in children (abstract). *Ann Allergy* 1981;47:PI39.
 23. Simons FER, Gu X, Watson WTA, Simons KJ. Pharmacokinetics of the orally administered decongestants pseudoephedrine and phenylpropanolamine in children. *J Pediatr* 1996;129:729-734.
 24. Data on File. Whitehall-Robins Healthcare. Clinical Study AQ-99-01. A single dose, randomized, open-label, single center, two-way crossover pharmacokinetic study of Advil Cold & Sinus tablets in children; 1999.
 25. Lucarotti RL, Colaizzi JL, Barry H III, Poust RI. Enhanced pseudoephedrine absorption by concurrent administration of aluminum hydroxide gel in humans. *J Pharm Sci* 1972;61:903-905.
 26. Williams BO, Liao SH, Lai AA, Arnold JP, Perkins JG, Blum MR, Findlay JW. Bioavailability of pseudoephedrine and triprolidine from combination and single ingredient products. *Clin Pharm* 1984;3:638-643.
 27. Dickerson J, Perrier D, Mayerson M, Bressler R. Dose tolerance and pharmacokinetic studies of L(+) pseudoephedrine capsules in man. *Eur J Clin Pharmacol* 1978;14:253-259.
 28. Baaske DM, Lai CM, Klein L, Look ZM, Yacobi A. Comparison of GLC and high- pressure liquid chromatographic methods for analysis of urinary pseudoephedrine. *J Pharm Sci* 1979;68:1472.
 29. Bye C, Hill HM, Hughes Dill, Peck AW. A comparison of plasma levels of L(+) pseudoephedrine following different formulations, and their relation to cardiovascular and subjective effects in man. *Eur J Clin Pharmacol* 1975;8:47-53.
 30. Delbeke FT, Debackere M. The influence of diuretics on the excretion and metabolism of adoping agents. VI. Pseudoephedrine. *Biopharm Drug Dispos* 1991;12:37-48.
 31. Lai CM, Stoll RG, Look ZM, Yacobi A. Urinary excretion of chlorpheniramine and pseudoephedrine in humans. *J Pharm Sci* 1979;68:1243-1246.
 32. Lo L Y, Land G, Bye A. Sensitive assay for pseudoephedrine and its metabolite, norpseudoephedrine in plasma and urine using gas-liquid chromatography with electron- capture detection. *J Chromatogr Biomed Appl* 1981;222:297-302.
 33. Brater DC, Kaojaren S, Benet LZ, Lin ET, Lockwood T, Morris RC, McSherry EJ, Melmond KL. Renal excretion of pseudoephedrine. *Clin Pharmacol Ther* 1980;28:690- 694.
 34. Kuntzman RG, Tsai I, Brand L, Mark LC. The influence of urinary pH on the plasma half- life of pseudoephedrine in man and dog and a sensitive assay for its determination in human plasma. *Clin Pharmacol Ther* 1971;12:62-67.
 35. Gu X, Simons KJ, St. Vincent JCM, Watson WTA, Reggin ill, Simons FER. Pseudoephedrine (PDE) pharmacokinetics and pharmacodynamics in children with allergic rhinitis (abstract). *J Allergy Clin Immunol* 1996;97:199.
 36. American Hospital Formulary Service Drug Evaluation -Pseudoephedrine. McEvoy GK, editor. Bethesda, MD: American Society of Health-System Pharmacists; 1998:1064-1066. 37. Findlay JWA, Butz RF, Sailstad JM, Warren T, Welch RM. Pseudoephedrine and triprolidine in plasma and breast milk of nursing mothers. *Br J Clin Pharmacol* 1984;18:901-906.

37. Findlay JWA, Butz RF, Sailstad JM, Warren JT, Welch RM. Pseudoephedrine and triprolidine in plasma and breast milk of nursing mothers. *Br J Clin Pharmacol* 1984;18:901-906.
38. Mortimer EA: Drug toxicity from breast milk? *Pediatrics* 1977; 60:780-781.
39. Schachtel BP, Fillingim IM, Thoden WR, Lane AC, Baybutt RI: Sore throat pain in the evaluation of mild analgesics. *Clin Pharmacol Ther* 1988; 44: 704-711.
40. Schachtel BP, Furey SA, Thoden WR: Nonprescription ibuprofen and acetaminophen in the treatment of tension-type headache. *J Clin Pharmacol* 1996; 36: 1120-1125.
41. Schachtel BP, Thoden WR: Onset of action of ibuprofen in the treatment of muscle-contraction headache. *Headache* 1988; 28: 471-474.
42. Braun RP, Lockhart EA, Bruno P: Delayed-onset muscle soreness (DOMS)- a new pain model to compare OTC analgesics. *Med Sci Sports Exer* 1994; 26: S14.
43. Minor MG, Schachtel BP: Antipyretic efficacy of ibuprofen 200 mg in adults with acute upper respiratory tract infection (URI). *J Clin Pharmacol*1990; 30: 846.
44. Jain AK, Vargas R, McMahon FG: The antipyretic effect of over-the-counter dosages of aspirin, acetaminophen and ibuprofen in endotoxin-induced fever. *Clin Pharmacol Ther* 1993; 53: 153.
45. Thoden WR, Lockhart EA: Antipyretic efficacy of ibuprofen and naproxen in flulike upper respiratory illness. *J Clin Pharmacol*1995; 35: 929.
46. Nahata MC, Powell DA, Durrell DE, Miller MA: Efficacy of ibuprofen in pediatric patients with fever. *Int J Clin Pharmacol Ther Toxicol* 1996; 30: 94-96.
47. Aksoylar S, Aksit S, Caglayan S, Yaprak I, Bakiler R, Cetin F: Evaluation of sponge and antipyretic medication to reduce body temperature in febrile children. *Acta Paediatr* 1997; 39: 215-217.
48. Autret E, Breart G, Jonvile AP, Courcier S, Lasalle C, Goehrs IM: Comparative efficacy and tolerance of ibuprofen syrup and acetaminophen syrup in children with pyrexia associated with infectious diseases and treated with antibiotics. *Eur J Clin Pharmacol*1994; 46: 197-201.
49. Autret E, Reboul-Marty J, Henry-Launois B, Laborde C, Courcier S, Goehrs JM, Languilat G, Launois R: Evaluation of ibuprofen versus aspirin and paracetamol on efficacy and comfort in children with fever. *Eur J ClinPharmacol*1997; 51: 367- 371.
50. Khubchandani RP, Ghatikar KN, Keny S, Usgaonkar NGS: Choice of antipyretic in children. *J Assoc Physicians India* 1995; 43: 614-616.
51. McIntyre J, Hull D: Comparing efficacy and tolerability of ibuprofen and paracetamol in fever. *Arch Dis Child* 1996; 74: 164-167.
52. Vauzelle-Kervroedan F, d' Athis P, Pariente-Khayat A, Debregeas S, Olive G, Pons G: Equivalent antipyretic activity of ibuprofen and paracetamol in febrile children. *J Pediatr* 1997; 131: 683-687.
53. Lockhart EA, Thoden WR, Furey SA, Schachtel BP: Ibuprofen and streptococcal sore throat pain in children. *Clin Pharmacol Ther* 1993; 53: 147.
54. Schachtel BP, King SA, Thoden WR: Pain relief in children; A placebo-controlled model. *Clin Pharmacol Ther* 1991; 49: 154.
55. Schachtel BP, Thoden WR: A placebo-controlled model for assaying systemic analgesics in children. *Clin Pharmacol Ther* 1993; 53: 593-601.
56. Data on File. A placebo-controlled comparison of the nasal decongestant effect of the combination of ibuprofen 400 mg with pseudoephedrine 60 mg to pseudoephedrine 60 mg on nasal airway resistance in patients with acute upper respiratory tract infection. Whitehall-Robins Healthcare Clinical Study WM-389; 1991.

57. Benson MK. Maximal nasal inspiratory flow rate: its use in assessing the effect of pseudoephedrine in vasomotor rhinitis. *Eur J Clin Pharmacol* 1971;3:182-184.
58. Cho YW. A new passive anterior rhinometric method for clinical study of nasal decongestant. *Int J Clin Pharmacol* 1978;16:63-67.
59. Roth RP, Cantekin EI, Bluestone CD, Welch RM, Cho YW. Nasal decongestant activity of pseudoephedrine. *Ann Otol* 1977;86:235-242.
60. Jawad SS, Ecces R. Effect of pseudoephedrine on nasal airflow in patients with nasal congestion associated with common cold. *Rhinology* 1998;36:73-76.
61. Taverner D, Dang C, Economos D. The effects of oral pseudoephedrine on nasal patency in the common cold: a double-blind single-dose placebo-controlled trial. *Clin Otolaryngol* 1999;24:47-51.
62. Data on File. A single-dose, double-blind, parallel, randomized, controlled study of nasal airflow rates in patients with nasal congestion treated with ibuprofen 200 mg and pseudoephedrine 30 mg compared with pseudoephedrine 30 mg, 45 mg, or 60 mg. Whitehall-Robins Healthcare Clinical Study WM-315A; 1987.
63. Drugdex, Pseudoephedrine Drugdex Drug Evaluations: MICROMEDEX, 2002.
64. Sudafed Nasal Decongestant Tablets 30 mg: Monographs from the 2002 Physicians Desk Reference. Montvale, New Jes, Doyle R, Culpepper-Morgan JA: Medical Economics Company Inc., 2002.
65. Dowd J, Bailey D, Moussa K, Nair et al: Ischemic colitis associated with pseudoephedrine: four cases. *Am J Gastroenterol* 1999; 94(9):2430-2434.
66. Buchanan BJ, Hoagland J, Fischer PR: Pseudoephedrine and air travel-associated ear pain in children. *Arch Pediatr Adolesc Med* 1999; 153:466-468.
67. Billings CE, Ralston RH, Hare DE: Untoward effects of a sympathomimetic amine. *Aerosp Med* 1974; 45(5):551-552.
68. Whelton A, Hamilton CW: Nonsteroidal anti-inflammatory drugs: Effects of kidney function. *J Clin Pharmacol* 1991; 588-598.
69. Novack SN: Side effect of ibuprofen therapy (letter). *Arthritis Rheum* 1973; 18(6):628.
70. Sica DA, Comstock TJ: Pseudoephedrine accumulation in renal failure. *Am J Med Sci* 1989; 298(4):261-263.
71. Nicasastro NJ: Visual disturbances associated with over-the-counter ibuprofen in three patients. *Ann Ophthalmol* 1989; 29:447-450.
72. Collum LMT, Bowen DI: Ocular side-effects of ibuprofen. *Br J Ophthalmol* 1971; 55(7):472-477.
73. Palmer CA: Toxic amblyopia from ibuprofen. *Br Med J* 1972; 3(829):765.
74. Asherov J, Schoenberg A, Weinberger A: Diplopia following ibuprofen administration (letter). *JAMA* 1982; 248(6):649.
75. Pugh CR, Howie SM: Dependence on pseudoephedrine (letter). *Br J Psychiatry* 1986; 149:798.
76. Diaz MA, Wise TN, Semchyshyn GO: Self-medication with pseudoephedrine in a chronically depressed patient. *Am J Psychiatry* 1979; 136(9):1217-1218.
77. Penner JA, Abbrecht PH: Lack of interaction between ibuprofen and warfarin. *Cuff Ther Res* 1975;18:862-871.
78. Slattery JT, Levy G: Effect of ibuprofen on protein binding of warfarin in human serum. *J Pharm Sci* 1977-66:1060.
79. Nierenberg DW: Competitive inhibition of methotrexate accumulation in rabbit kidney slices by non-steroidal anti-inflammatory drugs. *J Pharmacol Exper Ther* 1983;226(1):1-6.
80. Ragheb M, Alvin C: Ibuprofen can increase serum lithium in lithium treated patients. *J Clin*

- Psychiatry 1987; 48: 161-163.
81. Mork NL, Robertson RP: Effects of nonsteroidal antiinflammatory drugs in conventional dosage on glucose homeostatis in patients with diabetes. *West J Med* 1983; 139:45-49.
 82. Gontarz N, Small RE, Comstock TJ, Stalker DJ, Johnson SM, Willis BE: Effects of antacid suspension on the pharmacokinetics of ibuprofen. *Clin Pharm* 1987; 7(5):413-416.
 83. Furey SA, Thoden WR, Greene JJ, Schachtel BP: Side effect profile of ibuprofen with pseudoephedrine in upper respiratory tract infection. *J Clin Pharmacol* 1996; 36(9):857.
 83. Furey SA, Thoden WR, Greene JJ, Schachtel BP: Side effect profile of ibuprofen with pseudoephedrine in upper respiratory tract infection. *J Clin Pharmacol* 1966; 36(9):857.
 84. Sperber SJ, Sorrentino JV, Riker DK, Hayden FG: Evaluation of an alpha agonist alone and in combination with a nonsteroidal antiinflammatory agent in the treatment of experimental rhinovirus colds. *Bull NY Acad Med* 1989; 65(1): 145- 160.
 85. Doyle G, Furey S, Berlin R, Cooper S, Jayawardena S, AshrafE, Baird L: Gastrointestinal safety and tolerance of ibuprofen maximum over-the-counter use. *Aliment Pharmacol Ther* 1999; 13: 897-906.
 86. Furey SA, Waksman JA, Dash BH: Nonprescription ibuprofen: side effect profile. *Pharmacotherapy* 1992; 12: 403-407.
 87. DeArmond B, Francisco CA, Lin JS, Huang FY, Halladay S, Bartizek RD, Skare KL: Safety profile of over- the-counter naproxen sodium. *Clin Therap* 1995; 17: 587-601.
 88. Kellstein DE, Waksman JA, Binstok G, Furey SA, Cooper SA: The safety profile of nonprescription ibuprofen in multiple-dose use: a meta-analysis. *J Clin Pharmacol* 1999;39: 520-532.
 89. Rainsford KD, Roberts SC, Brown S: Ibuprofen and paracetamol: relative safety in non-prescription dosages. *J Pharm Pharmacol* 1997; 49: 345-376.
 90. Rainsford KD, Quadir M: Gastrointestinal damage and bleeding from non-steroidal anti-inflammatory drugs. I. Clinical and epidemiological aspects. *Inflammopharmacology* 1995; 3: 169-190.
 91. Strom BL: Gastrointestinal tract bleeding associated with naproxen sodium vs ibuprofen. *Arch Intern Med* 1997; 157: 2636-2631.
 92. Gutthann SA, Garcia-Rodriguez LA, Duque-Oliart A, Varas-Lorenzo C: Lowdose diclofenac, naproxen, and ibuprofen cohort study. *Pharmacoepidemiology* 199; 19: 854-859.
 93. Garcia Rodriguez LA, Williams R, Derby LE, Dean AD, Herschel J: Acute liver injury associated with non- steroidal anti-inflammatory drugs and the role of risk factors. *Arch Intern Med* 1994; 154: 311-316.
 94. Ashraf E, Ford, L, Geetha R, Cooper S: Safety profile of ibuprofen suspension in young children. *Inflammopharmacology* 1999, in press.
 95. Lesko SM, Mitchell AA: An assessment of the safety of pediatric ibuprofen. 1995; 273(12): 929-933.
 96. Lesko SM, Mitchell AA: Renal function after short-term ibuprofen use in infants and children. *Pediatrics* 1997; 100: 954-957.
 97. Lesko SM, Mitchell AA: The safety of acetaminophen and ibuprofen among children less than two years old. *Pediatrics* 1999 104 (4): 39-49.
 98. Franklin QJ: Sudden death after typhoid and Japanese encephalitis vaccination in a young male taking pseudoephedrine. *Mil Med* 1999;164(2):157-159.
 99. Rutstein HR: Ingestion of pseudoephedrine. *Arch Otolaryngol*1963; 77:145-147.
 100. Beary IF, 3rd: Pseudoephedrine producing postural hypotension in a pilot. *Aviat Space Environ*

- Med 1977; 48(4):369.
101. Wiener I, Tilkian AG, Palazzolo M: Coronary artery spasm and myocardial infarction in a patient with normal coronary arteries: temporal relationship to pseudoephedrine ingestion. *Cathet Cardiovasc Diagn* 1990;20(1):51-53.
 102. Brownstein MH: Fixed eruptions due to an ephedrine isomer. *Arch Dermatol* 1968; 97(2):115-119.
 103. Carnisa C: Fixed drug eruption due to pseudoephedrine. *Cutis* 1988; 41(5):339-340.
 104. Shelley WB, Shelley ED: Nonpigmenting fixed drug eruption as a distinctive reaction pattern: examples caused by sensitivity to pseudoephedrine hydrochloride and tetrabhydrozoline. *JAm Acad Dermatol* 1987; 17(3):403-407.
 105. Hauken M: Fixed drug eruption and pseudoephedrine (letter). *Ann Intern Med* 1994; 120:442.
 106. Hindioglu U, Sabin S: Nonpigmenting solitary fixed drug eruption caused by pseudoephedrine hydrochloride. *JAm Acad Dermatol* 1999; 38(3): 499-500.
 107. Taylor BJ, Duffill MB: Recurrent pseudo-scarlatina and allergy to pseudoephedrine hydrochloride. *Br J Dermatol* 1988; 118(6):827-829. 108. Spielberg SP, Schulman ill: A possible reaction to pseudoephedrine in a patient with phenylketonuria (letter). *J Pediatr* 1977; 90(6):1026.
 109. Cavanah DK, Ballas ZK: Pseudoephedrine reaction presenting as recurrent toxic shock syndrome. *Ann Intern Med* 1993; 119:302-303.
 110. Mattana J, Perinbasekar S, Brod-Miller C: *Am J Med Sci* 1997; 313:117-119.
 111. Kim J, Gazarian M, Verjee Z, Johnson D: Acute renal insufficiency in ibuprofen overdose. *Ped Emerg Care* 1995; 11(2): 107-108.
 112. Al-Harbi NN, Domrongkitchaipom S, Lireman DS: Hypocalcemia and hypomagnesemia after ibuprofen overdose. *Ann Pharmacother* 1997; 31: 432-434.
 113. Zuckerman GB, Uy CC: Shock, metabolic acidosis, and coma following ibuprofen overdose in a child. *Ann Pharmacother* 1995; 29(9): 869-871.
 114. Mariani PJ: Pseudoephedrine-induced hypertensive emergency: treatment with labetalol. *Am J Emerg Med* 1986; 4(2):141-142.
 115. Wezorek C, Dean B, Krenzelok E: Pseudoephedrine: a prospective study to establish a toxic dose in children. *Clin Toxicol* 1995; 33(5): 554.
 116. Saken R, Kates GL, Miller K: Drug-induced hypertension in infancy. *J Pediatr* 1979; 95(6):1077-1079.
 117. Roberge RJ, Hirani KH, Rowland PL, Berkeley R, Krenzelok EP: Dextromethorphan- and pseudoephedrine- induced agitated psychosis and ataxia: case report. *J Emerg Med* 1999; 17(2): 285-288.
 118. Sauder KL, Brady WJ Jr, Hennes H: Visual hallucinations in a toddler: Accidental ingestion of a sympathomimetic over-the-counter nasal decongestant. *Am J Emerg Med* 1997; 15(5): 521-526.
 119. Ackland PM: Hallucinations in a child after drinking triprolidine/pseudoephedrine linctus. *Lancet* 1984; 1(8387):1180.
 120. Leighton KM: Paranoid psychosis after abuse of Actifed. *Br Med J (Clin Res Ed)* 1982; 284(6318):789-790.
 121. Dalton R: Mixed bipolar disorder precipitated by pseudoephedrine hydrochloride. *South Med J* 1990; 83(1):64-65.
 122. Clark RF, Curry SC: Pseudoephedrine dangers. *Pediatrics* 1990; 85(3):389-390.
 123. Post-marketing surveillance Product Safety Update Report, 2001, Whitehall- Robins Healthcare.
 124. Utsunomiya T, Krausz MM, Dunham B, Valeri CR, Levine L, Shepro D, Hechtman HB:

- Modification of inflammatory response to aspiration with ibuprofen. *Am J Physiol* 1982; 243: H903-910.
125. Lillehei TJ, Metke MP, Dawnajee MK, Tago M, Lim MF, Kaye MP: Reduction of platelet deposition in aorto-coronary artery Gore- Tex bypass grafts in dogs by platelet inhibitors. *Circulation* 1980; 62: Suppl3; 53.
 126. Dipasquale G, Mellace D: Inhibition of arachidonic acid induced mortality in rabbits with several non- steroidal anti-inflammatory agents. *Agents Actions* 1977; 7: 481-485.
 127. Adesuyi SA, Ellis EF: The effect of ibuprofen dose on rabbit platelet aggregation and aortic PGI₂ synthesis. *Thromb Res* 1982; 28: 581-585.
 128. Imai H, Muramatsu Y, Tsurumi K, Fujimura H: Platelet aggregation and liposome as a model system (abstract). *Jap J Pharmacol* 1981; 31: 92P.
 129. Patil PN, Tye A, LaPidus JB: A pharmacological study of the ephedrine isomers. *J Pharmacol Exp Ther* 1965; 148:158-168.
 130. Aviado DM, Wnuck AL, De Beer EJ. Cardiovascular effects of sympathomimetic bronchodilators: epinephrine, ephedrine, pseudoephedrine, isoproterenol, methoxyphenamine, and isoprophephamine. *J Pharmacol Exp Ther* 1958;122:406-417.
 131. Aviado DM, Wnuck AL, De Beer ES. A comparative study of nasal decongestion by sympathomimetic drugs. *Arch Otolaryngol* 1959;69:589-605.
 132. Sandago BW, Fletcher HP. Glycemic response to selected sympathomimetics in stressed and normal goldthioglucose mice. *Pharmacology* 1983;27:110-116.
 133. Bye C, Dewsbury D, Peck A W. Effects on the human central nervous system of two isomers of ephedrine and triprolidine, and their interaction. *Br J Clin Pharmacol* 1974;1:71-78.
 134. Drew CDM, Knight GT, Hughes DTD, Bush M. Comparison of the effects of D(-) ephedrine and L-(+)- pseudoephedrine on the cardiovascular and respiratory systems in man. *Br J Clin Pharmacol* 1978;6:221-225.
 135. Empey DW, Young GA, Letley E, John GC, Smith P, McDonnell KA, et al: Doseresponse study of the nasal decongestant and cardiovascular effects of pseudoephedrine. *Br J Clin Pharmacol* 1980; 9(4):351-358.
 136. Chua SS, Benrimoj SI, Gordon RD, Williams G: A controlled clinical trial on the cardiovascular effects of single doses of pseudoephedrine in hypertensive patients. *Br J Clin Pharmacol* 1989; 28(3):369-372.
 137. Beck RA, Mercado DL, Seguin SM, Andrade WP, Cushner HM. Cardiovascular effects of pseudoephedrine in medically controlled hypertensive patients. *Arch Intern Med* 1992;152:1242-1245.
 138. Bradley JG, Kallail KJ, Dorsch IN, Fox J. The effects of pseudoephedrine on blood pressure in patients with controlled, uncomplicated hypertension: a randomized, double-blind, placebo-controlled trial. *J Am Board Fam Pract* 1991;4:201-206.
 139. Coates ML, Rembold CM, Farr BM. Does pseudoephedrine increase blood pressure in patients with controlled hypertension? *J Fam Pract* 1995;40:22-26.
 140. Gordon RD, Ballantine DM, Bachmann A W. Effects of repeated doses of pseudoephedrine on blood pressure and plasma catecholamines in normal subjects and in patients with phaeochromocytoma. *Clin Exp Pharmacol Physiol* 1992; 19: 287-290.
 141. Bright TP, Sandage BW, Jr., Fletcher IIP: Selected cardiac and metabolic responses to pseudoephedrine with exercise. *J Clin Pharmacol* 1981;21(11-12 Pt 1):488-492.
 142. Smith CV, Rayburn WF, Anderson JC, Duckworth AF, Appel LL: Effect of a single dose of oral pseudoephedrine on uterine and fetal Doppler blood flow. *Obstet Gynecol* 1990; 76(5 Pt 1): 803-

- 806.
143. Rombaut NEI, Alford C, Hindmarch I. Effects of oral administration of different formulations of pseudoephedrine on day- and night-time CNS activity. *Med Sci Res* 1989;17:831-834.
 144. Clemons JM, Crosby SL. Cardiopulmonary and subjective effects of a 60 mg dose of pseudoephedrine on graded treadmill exercise. *J Sports Med Phys Fitness* 1993;33:405-412.
 145. Gillies H, Derman WE, Noakes TD, Smith P, Evans A, Gabriels G. Pseudoephedrine is without effects during prolonged exercise. *J Appl Physiol* 1996;81:2611-2617.
 146. Swain RA, Harsha DM, Baenziger J, Saywell RM Jr. Do pseudoephedrine and phenylpropanolamine improve maximum oxygen uptake and time to exhaustion. *Clin J Sports Med* 1997;7:168-173.
 147. Laitinen LA, Empey DW, Bye C, Britton MG, McDonnell K, Hughes DTD. A comparison of the bronchodilator action of pseudoephedrine and ephedrine in patients with reversible airway obstruction. *Eur J Clin Pharmacol* 1982;23: 107- 109.
 148. Adams SS, Bough RG, Cliffe BE, Dickinson W, Lessel B, McCullough KF, Mills RFN, Nicholson JS, Williams GAH: Some aspects of the pharmacology, metabolism and toxicology of ibuprofen. *Rheum Phys Med Suppl* 1970: 9-14.
 149. Anonymous. Acute Overdose Manual. Sudafed. Burroughs Wellcome Co; 1982: 99.
 151. Packman EW, Doyle G, Koronkiewicz K, Jayawardina S, Cooper SA: Onset of analgesia of ibuprofen liquigels (400 mg) compared to acetaminophen caplets (1000 mg) in the treatment of tension headache. *J Clin Pharmacol* 1998; 38: 876.
 152. USPDI 2002, p.426-427.
 153. Fommei E, Ghione S, Palla L, Ragazzini A, Gazzetti P, Palombo C, Giaconi S: Inhibition of prostaglandins and angiotensin II: Effects on renal function in hypertensive patients. *Agents Actions Suppl* 1987; 22: 183-189.
 154. Cook ME, Wallin JD, Thakur VD, Kadowitz PJ, McNamara DB, Garcia MM, Lipani JJ, Poland M: Comparative effects of nabumetone, sulindac and ibuprofen on renal function. *J Rheumatol* 1997; 24: 1137-1144.
 155. Minuz P, Lechi A, Arosio E, Degan M, Capuzzo MG, Lechi C, Corsato M, Dalla Riva A, Velo GP: antihypertensive activity of enalapril. Effect of ibuprofen and different salt intakes. *J Clin Hypertens* 1987; 3: 645-653.
 156. Jorgenson HS, Christensen HR, Kampmann JP: Interaction between digoxin and indomethacin or ibuprofen. *Br J Clin Pharmacol* 1991; 31(1): 108-110.
 157. Johnson AG, Nguyen TV, Day RO: Do non-steroidal anti-inflammatory drugs affect blood pressure? *Ann Intern Med* 1994; 121: 289-300.
 158. Pope JG, Anderson JJ, Felson DT: A meta-analysis of the effects of non-steroidal anti-inflammatory drugs on blood pressure. *Arch Intern Med* 1993; 153: 477-484.
 159. Davies JG, Rawlins DC, Busson M: Effect of ibuprofen on blood pressure control by propranolol and benzofluazide. *J Intern Med Res* 1988; 16: 173-181.
 160. Houston MC, Weir M, Gray J, Ginsberg D, Szeto C, Kathlenen PM, Sugimoto D, Lefkowitz M, Runde M: The effects of non-steroidal anti-inflammatory drugs on blood pressure of patients with hypertension controlled by verapamil. *Arch Intern Med* 1995; 155: 1049-1054.
 161. USP DI. Drug Information for the Health Care Professional, Anti-Inflammatory Drugs, Nonsteroidal (Systemic). Thomson MICROMEDEX, 2005; 1:390.
 162. Advil Cold & Sinus Caplets Product Monograph. Control No. 143529, March 17, 2011.

PART III: CONSUMER INFORMATION

**Ibuprofen+Pseudoephedrine Caplets
Ibuprofen and Pseudoephedrine Hydrochloride
Tablets USP**

This leaflet is part III of a three-part "Product Monograph" published when Ibuprofen+Pseudoephedrine Caplets was approved for sale in Canada and is designed specifically for Consumers. This leaflet is a summary and will not tell you everything about Ibuprofen & Pseudoephedrine Hydrochloride Caplets. Contact your doctor or pharmacist if you have any questions about the drug.

ABOUT THIS MEDICATION

What the medication is used for:

Fast, temporary relief of the symptoms of colds including sinus pain, nasal congestion, headache, fever, body aches and pains.

What it does:

Ibuprofen reduces pain and fever. Pseudoephedrine hydrochloride is a nasal decongestant.

When it should not be used:

Do not use Ibuprofen+Pseudoephedrine Caplets if:

- allergic/hypersensitive to acetylsalicylic acid (ASA), ibuprofen, other salicylates, other non-steroidal anti-inflammatory drugs (NSAIDs), pseudoephedrine or other sympathomimetic amines or any of Ibuprofen+Pseudoephedrine Caplets ingredients (Refer to the nonmedicinal ingredients section of this insert),
- peptic ulcer disease or gastrointestinal bleeding,
- taking a monoamine oxidase inhibitor (MAOI) or for 14 days after stopping the MAOI drug, ASA or other NSAIDs including any other ibuprofen product,
- nasal polyps (swelling of the inside of the nose),
- asthma,
- allergic manifestations such as anaphylaxis (sudden severe life threatening allergic reaction), urticaria/hives, rhinitis (stuffed or runny nose that may be due to allergies), skin rash or other allergic symptoms,
- dehydrated (significant fluid loss) due to vomiting, diarrhea or lack of fluid intake,
- been diagnosed with severe high blood pressure or have heart disease,
- about to have or just had heart surgery,
- serious liver disease,
- severe kidney disease,

- thyroid disease,
- Raynaud's Syndrome (a disorder of the circulatory system),
- Systemic Lupus Erythematosus,
- pregnant or nursing.

What the medicinal ingredients are:

Ibuprofen and pseudoephedrine hydrochloride.

What the nonmedicinal ingredients are:

Pregelatinized starch, Microcrystalline cellulose, Povidone, Stearic acid, Sodium Lauryl Sulphate, Croscarmellose Sodium, Colloidal Silicon Dioxide and Opadry AMB Brown (contains, polyvinyl alcohol, titanium dioxide, talc, yellow iron oxide, iron oxide red, lecithin, xanthan gum.)

What dosage forms it comes in:

Each caplet contains ibuprofen 200 mg, pseudoephedrine hydrochloride 30 mg.

WARNINGS AND PRECAUTIONS

Serious Warnings and Precautions

- Caution in patients at risk of gastrointestinal tract irritation,
- Patients at risk of kidney problems, including the elderly or those using diuretics.
- Use during pregnancy or nursing should be avoided.
- Stop use immediately if you have difficulty or pain when urinating.

BEFORE you use Ibuprofen+Pseudoephedrine Caplets talk to your doctor or pharmacist if you have:

- blood clotting disorder (such as hemophilia)
- breathing problems or chronic lung disease (such as chronic bronchitis)
- diabetes,
- difficulty in urination due to prostate enlargement
- glaucoma
- high blood pressure
- mild to moderate kidney disease
- mild to moderate liver disease
- any other serious disease, are under doctor's care for any serious condition, or are taking any other drug including over the counter drugs.

INTERACTIONS WITH THIS MEDICATION

Do not use this product if you are taking:

a MAOI or if you have stopped taking one within the past two weeks.

- ASA or other anti-inflammatory medication.

Drugs that may interact with Ibuprofen+Pseudoephedrine Caplets include:

- Acetaminophen
- Acetylsalicylic acid (ASA)
- Allergy medications
- Anticoagulants (blood thinning medications)
- Antidepressants
- Anti-hypertensives (blood pressure medications)
- Antibiotics (levofloxacin)
- Benzodiazapines
- Cold medications
- Corticosteroids
- Cyclosporine
- Diabetes medication (including insulin and oral antidiabetic agents)
- Digoxin
- Diuretics (water pills)
- Lithium
- Methotrexate
- Monoamine Oxidase Inhibitors
- Nonsteroidal anti-inflammatory drugs (NSAIDs); including naproxen and ibuprofen
- Phenytoin
- Probenecid
- Thyroxine

PROPER USE OF THIS MEDICATION

Usual dose:

Adults under 65 of years and children over 12: Take 1 or 2 caplets every 4 to 6 hours as needed. Do not exceed six caplets in 24 hours, unless directed by a physician.

Do not give to children under 12. Do not use longer than 3 days for a fever or 5 days for pain or cold symptoms.

Overdose:

In case of accidental overdose, call a Poison Control Centre or a doctor immediately, even if there are no symptoms.

Missed Dose:

Continue to take 1 or 2 caplets every 4 to 6 hours as needed after a missed dose. Do not take twice the recommended dose following a missed dose.

SIDE EFFECTS AND WHAT TO DO ABOUT THEM

Ibuprofen+Pseudoephedrine Caplets may occasionally produce unwanted side effects, such as heartburn, constipation, nausea, bloating, nervousness or sleeplessness.

Stop use and contact a doctor or pharmacist if these symptoms worsen or persist.

The risk of having side effects may be decreased by using the smallest dose for the shortest duration of time.

SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM

Symptom/effect		Talk with your doctor or pharmacist		Seek immediate emergency medical assistance
		Only if severe	In all cases	
Uncommon	Symptoms of allergic reaction, including: rash, severe itching/redness, blisters, swelling, or trouble breathing			√
	Blood in vomit, bloody or black stools			√
	Abdominal pain, vomiting, diarrhea		√	
	Ringing or buzzing in the ears / dizziness		√	
	Change in vision,		√	
	Fluid retention		√	

This is not a complete list of side effects. For any unexpected effects while taking Ibuprofen+Pseudoephedrine Caplets, contact your doctor or pharmacist.

REPORTING SUSPECTED SIDE EFFECTS

You can report any suspected adverse reactions associated with the use of health products to the Canada Vigilance Program by one of the following 3 ways:

1. Report online at www.healthcanada.gc.ca/medeffect
2. Call toll-free at 1-866-234-2345
3. Complete a Canada Vigilance Reporting Form and:
 - Fax toll-free to 1-866-678-6789, or
 - Mail to: Canada Vigilance Program
Health Canada
Postal Locator 0701D
Ottawa, ON K1A 0K9

Postage paid labels, Canada Vigilance Reporting Form and the adverse reaction reporting guidelines are available on the MedEffect™ Canada Web site at www.healthcanada.gc.ca/medeffect.

NOTE: Should you require information related to the management of side effects, contact your health professional.

The Canada Vigilance Program does not provide medical advice.

HOW TO STORE IT

Store at room temperature (15°C-30°C).

Keep out of reach of children. This package contains enough medicine to seriously harm a child.

MORE INFORMATION

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