

SUMMARY OF PRODUCT CHARACTERISTICS

1 NAME OF THE MEDICINAL PRODUCT

Amoxicillin 1g, powder for solution for injection/ infusion

2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each vial contains 1 g of amoxicillin.

Excipient with known effect : sodium 2.74 mmol/ vial

This medicine contains approximately 63 mg sodium per vial, equivalent to 3.15 % of the WHO recommended maximum daily intake of 2 g sodium for an adult.

3 PHARMACEUTICAL FORM

Powder for Solution for Injection or Infusion.

4 CLINICAL PARTICULARS

4.1 Therapeutic indications

Amoxicillin is indicated for the treatment of the following infections in adults and children (see sections 4.2, 4.4 and 5.1):

- Severe infections of the ear, nose and throat (such as mastoiditis, peritonsillar infections, epiglottitis, and sinusitis when accompanied by severe systemic signs and symptoms)
- Acute exacerbations of chronic bronchitis
- Community acquired pneumonia
- Acute cystitis
- Acute pyelonephritis

- Severe dental abscess with spreading cellulitis
- Prosthetic joint infections
- Lyme disease
- Bacterial meningitis
- Bacteremia that occurs in association with, or is suspected to be associated with, any of the infections listed above

Amoxicillin is also indicated for the treatment and prophylaxis of endocarditis.

Consideration should be given to official guidance on the appropriate use of antibacterial agents.

4.2 Posology and method of administration

Posology

The dose of amoxicillin that is selected to treat an individual infection should take into account:

- The expected pathogens and their likely susceptibility to antibacterial agents (see section 4.4)
- The severity and the site of the infection
- The age, weight and renal function of the patient; as shown below

The duration of therapy should be determined by the type of infection and the response of the patient, and should generally be as short as possible. Some infections require longer periods of treatment (see section 4.4 regarding prolonged therapy).

Adults and children \geq 40 kg

Indication*	Dose*
Severe infections of the ear, nose and throat (such as mastoiditis, peritonsillar infections, epiglottitis and sinusitis when accompanied by severe systemic signs and symptoms)	750 mg to 2 g every 8 hours, or 2 g every 12 hours, maximum of 12 g/day
Acute exacerbations of chronic bronchitis	
Community acquired pneumonia	
Acute cystitis	

Acute pyelonephritis	
Severe dental abscess with spreading cellulitis	
Prosthetic joint infections	750 mg to 2 g every 8 hours, or 2 g every 12 hours, maximum of 12 g/day
Prophylaxis of endocarditis	2 g single dose 30 to 60 minutes before procedure.
Treatment of endocarditis	1 g to 2 g every 4 to 6 hours, maximum of 12 g/day
Bacterial meningitis	1 g to 2 g every 4 to 6 hours, maximum of 12 g/day
Lyme disease (see section 4.4)	Late stage (systemic involvement): 2 g every 8 hours
Bacteraemia that occurs in association with, or is suspected to be associated with, any of the infections listed in section 4.1	1 g to 2 g every 4, 6 or 8 hours, maximum of 12 g/day
*Consideration should be given to the official treatment guidelines for each indication	

Intramuscular

Maximum daily dosage: 4 g/day.

Maximum single dose: 1 g.

Paediatric population

Infants and toddlers >3 months and children <40 kg	Dose*
Indication*	
Severe infections of the ear, nose and throat (such as mastoiditis, peritonsillar infections, epiglottitis and sinusitis when accompanied by severe systemic signs and symptoms	20 to 200 mg/kg/day given in 2 to 4 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Community acquired pneumonia	
Acute cystitis	
Acute pyelonephritis	
Severe dental abscess with spreading cellulitis	

Prophylaxis of endocarditis	50 mg/kg single dose 30 to 60 minutes before procedure
Treatment of endocarditis	200 mg/kg/day in 3 to 4 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Bacterial meningitis	100 to 200 mg/kg/day in 3 to 4 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Lyme disease (see section 4.4)	Early stage: 25 to 50 mg/kg/day in three divided doses for 10 days (range 10 to 21 days) Late stage (systemic involvement): 50 mg/kg/day in three divided doses
Bacteraemia that occurs in association with, or is suspected to be associated with, any of the infections listed in section 4.1	50 to 150 mg/kg/day given in 3 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
*Consideration should be given to the official treatment guidelines for each indication.	

Neonates \geq 4 kg and infants up to 3 months	Dose*
Indication*	
Most infections	Usual daily dose of 20 to 150 mg/kg/day given in 3 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Treatment of endocarditis	150 mg/kg/day given in 3 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Bacterial meningitis	150 mg/kg/day given in three divided doses
Lyme disease (see section 4.4)	Early stage: 25 to 50 mg/kg/day in three divided doses for 10 days (range 10 to 21 days) Late stage (systemic involvement): 50 mg/kg/day in three divided doses
Bacteraemia that occurs in association with, or is suspected to be associated with, any of the infections listed in section 4.1	Usual daily dose of 50 to 150 mg/kg/day given in 3 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg

*Consideration should be given to the official treatment guidelines for each indication.

Premature Neonates \leq 4 kg	Dose*
Indication*	
Most infections	Usual daily dose of 20 to 100 mg/kg/day given in 2 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
Treatment of endocarditis	100 mg/kg/day given in two divided doses
Bacterial meningitis	100 mg/kg/day given in two divided doses
Lyme disease (see section 4.4)	Early stage: 25 to 50 mg/kg/day in two divided doses for 10 days (range 10 to 21 days) Late stage (systemic involvement): 50 mg/kg/day in two divided doses
Bacteraemia that occurs in association with, or is suspected to be associated with, any of the infections listed in section 4.1	Usual daily dose of 50 to 100 mg/kg/day given in 2 equally divided doses of up to 25 mg/kg or infusions of up to 50 mg/kg
*Consideration should be given to the official treatment guidelines for each indication.	

Intramuscular:

Maximum daily dosage: 120 mg/kg/day as 2 to 6 equally divided doses.

Elderly

No adjustment needed; as for adults.

Renal impairment

GFR (ml/min)	Adults and children \geq 40 kg		Children < 40 kg	
	Intravenous	Intramuscular	Intravenous	Intramuscular
Greater than 30	No adjustment	No adjustment	No adjustment	No adjustment
10 to 30	1 g start, then 500 mg to 1g twice daily	500 mg every 12 hours	25 mg/kg twice daily	15 mg/kg every 12 hours

Less than 10	1 g stat, then 500mg/day	500 mg/day given as a single dose	25 mg/kg/day given as a single dose	15 mg/kg/day given as a single dose
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In patients receiving haemodialysis and peritoneal dialysis:

Amoxicillin may be removed from the circulation by haemodialysis.

	Haemodialysis		Peritoneal dialysis	
	Intravenous	Intramuscular	Intravenous	Intramuscular
Adults and children \geq 40 kg	1 g at the end of dialysis, then 500 mg every 24 hours	500 mg during dialysis, 500 mg at the end, then 500 mg every 24 hours	1 g start, then 500 mg/day	500 mg/day given as a single dose
Children < 40 kg	25 mg/kg stat and 12.5 mg/kg at the end of the dialysis, then 25 mg/kg/day	15 mg/kg during and at the end of dialysis, then 15 mg/kg every 24 hours	25 mg/kg/day given as a single dose	15 mg/kg/day given as a single dose

Method of Administration

The standard recommended route of administration is by intravenous injection or intravenous infusion. Intramuscular administration should only be considered when the intravenous route is not possible or less appropriate for the patient.

Intravenous

Amoxicillin may be administered either by slow intravenous injection over a period of 3 to 4 minutes directly into a vein or via a drip tube or by infusion over 20 to 30 minutes.

Intramuscular

The maximum single dose is 1 g in adults and children > 40 kg.

Do not inject more than 60 mg/kg at one time in children < 40 kg.

4.3 Contraindications

Hypersensitivity to the active substance or to any of the penicillins.

History of a severe immediate hypersensitivity reaction (e.g. anaphylaxis) to another beta-lactam agent (e.g. a cephalosporin, carbapenem or monobactam).

4.4 Special warnings and precautions for use

Hypersensitivity reactions

Before initiating therapy with amoxicillin, careful enquiry should be made concerning previous hypersensitivity reactions to penicillins, cephalosporins or other beta-lactam agents (see sections 4.3 and 4.8).

Serious and occasionally fatal hypersensitivity reactions (including anaphylactoid and severe cutaneous adverse reactions) have been reported in patients on penicillin therapy.

Hypersensitivity reactions can also progress to Kounis syndrome, a serious allergic reaction that can result in myocardial infarction (see section 4.8).

These reactions are more likely to occur in individuals with a history of penicillin hypersensitivity and in atopic individuals. If an allergic reaction occurs, amoxicillin therapy must be discontinued and appropriate alternative therapy instituted.

Drug-induced enterocolitis syndrome (DIES) has been reported mainly in children receiving amoxicillin (see section 4.8). DIES is an allergic reaction with the leading symptom of protracted vomiting (1-4 hours after drug administration) in the absence of allergic skin or respiratory symptoms. Further symptoms could comprise abdominal pain, diarrhoea, hypotension or leucocytosis with neutrophilia. There have been severe cases including progression to shock.

Non-susceptible microorganisms

Amoxicillin is not suitable for the treatment of some types of infection unless the pathogen is already documented and known to be susceptible or there is a very high likelihood that the pathogen would be suitable for treatment with amoxicillin (see section 5.1). This particularly applies when considering the treatment of patients with urinary tract infections and severe infections of the ear, nose and throat.

Convulsions

Convulsions may occur in patients with impaired renal function or in those receiving high doses or in patients with predisposing factors (e.g. history of seizures, treated epilepsy or meningeal disorders (see section 4.8).

Renal impairment

In patients with renal impairment, the dose should be adjusted according to the degree of impairment (see section 4.2).

Skin reactions

The occurrence at the treatment initiation of a feverish generalised erythema associated with pustula may be a symptom of acute generalised exanthemous pustulosis (AEGP, see section 4.8). This reaction requires amoxicillin discontinuation and contra-indicates any subsequent administration.

Amoxicillin should be avoided if infectious mononucleosis is suspected since the occurrence of a morbilliform rash has been associated with this condition following the use of amoxicillin.

Jarisch-Herxheimer reaction

The Jarisch-Herxheimer reaction has been seen following amoxicillin treatment of Lyme disease (see section 4.8). It results directly from the bactericidal activity of amoxicillin on the causative bacteria of Lyme disease, the spirochaete *Borrelia burgdorferi*. Patients should be reassured that this is a common and usually self-limiting consequence of antibiotic treatment of Lyme disease.

Overgrowth of non-susceptible microorganisms

Prolonged use may also occasionally result in overgrowth of non-susceptible organisms.

Antibiotic-associated colitis has been reported with nearly all antibacterial agents and may range in severity from mild to life threatening (see section 4.8). Therefore, it is important to consider this diagnosis in patients who present with diarrhoea during, or subsequent to, the administration of any antibiotics. Should antibiotic-associated colitis occur, amoxicillin should immediately be discontinued, a physician consulted and an appropriate therapy initiated. Anti-peristaltic medicinal products are contraindicated in this situation.

Prolonged therapy

Periodic assessment of organ system functions; including renal, hepatic and haematopoietic function is advisable during prolonged therapy. Elevated liver enzymes and changes in blood counts have been reported (see section 4.8).

Anticoagulants

Prolongation of prothrombin time has been reported rarely in patients receiving amoxicillin. Appropriate monitoring should be undertaken when anticoagulants are prescribed concomitantly. Adjustments in the dose of oral anticoagulants may be necessary to maintain the desired level of anticoagulation (see section 4.5 and 4.8).

Crystalluria

In patients with reduced urine output, crystalluria (including acute renal injury) has been observed very rarely, predominantly with parenteral therapy. During the administration of high doses of amoxicillin, it is advisable to maintain adequate fluid

intake and urinary output in order to reduce the possibility of amoxicillin crystalluria. In patients with bladder catheters, a regular check of patency should be maintained (see sections 4.8 and 4.9).

Interference with diagnostic tests

Elevated serum and urinary levels of amoxicillin are likely to affect certain laboratory tests. Due to the high urinary concentrations of amoxicillin, false positive readings are common with chemical methods.

It is recommended that when testing for the presence of glucose in urine during amoxicillin treatment, enzymatic glucose oxidase methods should be used.

The presence of amoxicillin may distort assay results for oestriol in pregnant women.

Important information about excipients

Amoxicillin 1g contains 63 mg sodium per vial (2.74 mmol of sodium), equivalent to 3.15% of the WHO recommended maximum daily intake of 2 g sodium for an adult. This should be taken into consideration by patients on a sodium controlled diet.

Lidocaine may be used only when administering amoxicillin by the intramuscular route.

4.5 Interaction with other medicinal products and other forms of interaction

Probenecid

Concomitant use of probenecid is not recommended. Probenecid decreases the renal tubular secretion of amoxicillin. Concomitant use of probenecid may result in increased and prolonged blood levels of amoxicillin.

Allopurinol

Concurrent administration of allopurinol during treatment with amoxicillin can increase the likelihood of allergic skin reactions.

Tetracyclines

Tetracyclines and other bacteriostatic drugs may interfere with the bactericidal effects of amoxicillin.

Oral anticoagulants

Oral anticoagulants and penicillin antibiotics have been widely used in practice without reports of interaction. However, in the literature there are cases of increased

international normalised ratio in patients maintained on acenocoumarol or warfarin and prescribed a course of amoxicillin. If coadministration is necessary, the prothrombin time or international normalised ratio should be carefully monitored with the addition or withdrawal of amoxicillin. Moreover, adjustments in the dose of oral anticoagulants may be necessary (see sections 4.4 and 4.8).

Methotrexate

Penicillins may reduce the excretion of methotrexate causing a potential increase in toxicity.

4.6 Fertility, pregnancy and lactation

Pregnancy

Animal studies do not indicate direct or indirect harmful effects with respect to reproductive toxicity. Limited data on the use of amoxicillin during pregnancy in humans do not indicate an increased risk of congenital malformations. Amoxicillin may be used in pregnancy when the potential benefits outweigh the potential risks associated with treatment.

Breast-feeding

Amoxicillin is excreted into breast milk in small quantities with the possible risk of sensitisation. Consequently, diarrhoea and fungus infection of the mucous membranes are possible in the breast-fed infant, so that breast-feeding might have to be discontinued. Amoxicillin should only be used during breastfeeding after benefit/risk assessment by the physician in charge.

Fertility

There are no data on the effects of amoxicillin on fertility in humans. Reproductive studies in animals have shown no effects on fertility.

4.7 Effects on ability to drive and use machines

No studies on the effects on the ability to drive and use machines have been performed. However, undesirable effects may occur (e.g. allergic reactions, dizziness, convulsions), which may influence the ability to drive and use machines (see section 4.8).

4.8 Undesirable effects

The most commonly reported adverse drug reactions (ADRs) are diarrhoea, nausea and skin rash.

The ADRs derived from clinical studies and post-marketing surveillance with amoxicillin, presented by MedDRA System Organ Class are listed below.

The following terminologies have been used in order to classify the occurrence of undesirable effects.

Very common ($\geq 1/10$)

Common ($\geq 1/100$ to $< 1/10$)

Uncommon ($\geq 1/1,000$ to $< 1/100$)

Rare ($\geq 1/10,000$ to $< 1/1,000$)

Very rare ($< 1/10,000$)

Not known (cannot be estimated from the available data)

Infections and infestations

Very rare: Mucocutaneous candidiasis

Blood and lymphatic system disorders

Very rare: Reversible leucopenia (including severe neutropenia or agranulocytosis), reversible thrombocytopenia and haemolytic anaemia.

Prolongation of bleeding time and prothrombin (see section 4.4)

Cardiac disorders

Not known: Kounis syndrome

Immune system disorders

Very rare: Severe allergic reactions, including angioneurotic oedema, anaphylaxis, serum sickness and hypersensitivity vasculitis (see section 4.4).

Not known: Jarisch-Herxheimer reaction (see section 4.4)

Nervous system disorders

Very rare: Hyperkinesia, dizziness, aseptic meningitis and convulsions (see section 4.4).

Not known: Aseptic meningitis

Gastrointestinal disorders

Clinical Trial Data

*Common: Diarrhoea and nausea.

*Uncommon: Vomiting.

Post-marketing Data

Very rare: Antibiotic associated colitis including pseudomembraneous colitis and haemorrhagic colitis (see section 4.4).

Not known: Drug-induced enterocolitis syndrome

Hepatobiliary disorders

Very rare: Hepatitis and cholestatic jaundice; a moderate rise in AST and/or ALT.

Skin and subcutaneous tissue disorders

Clinical Trial Data

*Common: Skin rash

*Uncommon: Urticaria and pruritus

Post-marketing Data

Very rare: Skin reactions such as erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, bullous and exfoliative dermatitis, acute generalised exanthematous pustulosis (AGEP) (see section 4.4) and drug reaction with eosinophilia and systemic symptoms (DRESS).

Not known: Linear IgA disease

Renal and urinary disorders

Very rare: Interstitial nephritis, crystalluria (including acute renal injury) (see sections 4.4 and 4.9).

* The incidence of these AEs was derived from clinical studies involving a total of approximately 6,000 adult and paediatric patients taking amoxicillin.

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the Yellow Card Scheme at www.mhra.gov.uk/yellowcard or search for MHRA Yellow Card in the Google Play or Apple App Store.

4.9 Overdose

Symptoms and signs of overdose

Gastrointestinal symptoms (such as nausea, vomiting and diarrhoea) and disturbance of the fluid and electrolyte balances may be evident. Amoxicillin crystalluria, in some cases leading to renal failure, has been observed. Convulsions may occur in patients with impaired renal function or in those receiving high doses (see sections 4.4 and 4.8).

Amoxicillin has been reported to precipitate in bladder catheters, predominantly after intravenous administration of large doses. A regular check of patency should be maintained (see section 4.4)

Treatment of intoxication

Gastrointestinal symptoms may be treated symptomatically, with attention to the water/electrolyte balance.

Amoxicillin can be removed from the circulation by haemodialysis.

5 PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Penicillins with extended spectrum, ATC code: J01CA04

Mechanism of action

Amoxicillin is a semisynthetic penicillin (beta-lactam antibiotic) that inhibits one or more enzymes (often referred to as penicillin-binding proteins, PBPs) in the biosynthetic pathway of bacterial peptidoglycan, which is an integral structural component of the bacterial cell wall. Inhibition of peptidoglycan synthesis leads to weakening of the cell wall, which is usually followed by cell lysis and death. Amoxicillin is susceptible to degradation by beta-lactamases produced by resistant bacteria and therefore the spectrum of activity of amoxicillin alone does not include organisms which produce these enzymes.

Pharmacokinetic/pharmacodynamic relationship

The time above the minimum inhibitory concentration ($T > MIC$) is considered to be the major determinant of efficacy for amoxicillin.

Mechanisms of resistance

The main mechanisms of resistance to amoxicillin are:

- Inactivation by bacterial beta-lactamases.
- Alteration of PBPs, which reduce the affinity of the antibacterial agent for the target.

Impermeability of bacteria or efflux pump mechanisms may cause or contribute to bacterial resistance, particularly in Gram-negative bacteria.

EUCAST breakpoints, V12.0 valid from 2022-01-01 are as follows:

EUCAST (European Committee on Antimicrobial Susceptibility Testing) breakpoints (v. 12.0)

Organism	MIC breakpoint (mg/L)	
	Susceptible ≤	Resistant >
Enterobacteriaceae	8 ¹	8
<i>Staphylococcus</i> spp.	Note ²³⁴	Note
<i>Enterococcus</i> spp. ⁵	4 ⁶	8
Streptococcus groups A, B, C and G	Note ⁷	Note ⁷
<i>Streptococcus pneumoniae</i> : Amoxicillin IV (indications other than meningitis)	Note ^{8,9}	Note ^{8,9}
<i>Streptococcus pneumoniae</i> : Amoxicillin IV (meningitis)	0.5	0.5
Viridans group streptococci	0.5	2
<i>Haemophilus influenzae</i> : Amoxicillin IV (indications other than meningitis) ¹⁰	2	2
<i>Moraxella catarrhalis</i>	Note ¹¹	Note ¹¹
<i>Neisseria gonorrhoeae</i>	Note ¹²	Note ¹²
<i>Neisseria meningitidis</i>	0.125	1
<i>Pasteurella multocida</i>	1	1
<i>Aerococcus sanguinicola</i> and <i>urinae</i>	Note ¹³	Note ¹³
<i>Kingella kingae</i>	0.125 ¹⁴	0.125 ¹⁴

^{1/} Aminopenicillin breakpoints in Enterobacterales are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only. Breakpoints for other infections are under review.

^{2/} Most *S. aureus* are penicillinase producers and some are methicillin resistant. Either mechanism renders them resistant to benzylpenicillin, phenoxymethylpenicillin, ampicillin, amoxicillin, piperacillin and ticarcillin. Isolates that test susceptible to benzylpenicillin and cefoxitin can be reported susceptible to all penicillins. Isolates that test resistant to benzylpenicillin but susceptible to cefoxitin are susceptible to β -lactam β -lactamase inhibitor combinations, the isoxazolympenicillins (oxacillin, cloxacillin, dicloxacillin and flucloxacillin) and nafcillin. For agents given orally, care to achieve sufficient exposure at the site of the infection should be exercised. Isolates that test resistant to cefoxitin are resistant to all penicillins.

^{3/} Most coagulase-negative staphylococci are penicillinase producers and some are methicillin resistant. Either mechanism renders them resistant to benzylpenicillin, phenoxymethylpenicillin, ampicillin, amoxicillin, piperacillin and ticarcillin. No currently available method can reliably detect penicillinase production in all species of staphylococci but methicillin resistance can be detected with cefoxitin as described.

^{4/} Ampicillin susceptible *S. saprophyticus* are mecA -negative and susceptible to ampicillin, amoxicillin and piperacillin (without or with a beta-lactamase inhibitor).

^{5/} Aminopenicillin breakpoints in enterococci are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only.

^{6/} Susceptibility to ampicillin, amoxicillin and piperacillin (with and without beta-lactamase inhibitor) can be inferred from ampicillin. Ampicillin resistance is uncommon in *E. faecalis* (confirm with MIC) but common in *E. faecium*.

^{7/} The susceptibility of streptococcus groups A, B, C and G to penicillins is inferred from the benzylpenicillin susceptibility (indications other than meningitis) with the exception of phenoxymethylpenicillin and isoxazolympenicillins for streptococcus group B.

^{8/} The oxacillin 1 μ g disk diffusion screening test or a benzylpenicillin MIC test shall be used to exclude beta-lactam resistance mechanisms. When the screen is negative (oxacillin inhibition zone ≥ 20 mm, or benzylpenicillin MIC ≤ 0.06 mg/L) all beta-lactam agents for which clinical breakpoints are available, including those with "Note" can be reported susceptible without further testing, except for cefaclor, which if reported, should be reported as "susceptible, increased exposure" (I). When the screen is positive (oxacillin zone 0.06 mg/L), see flow chart below.

^{9/} Susceptibility inferred from ampicillin (indications other than meningitis).

^{10/} Beta-lactamase positive isolates can be reported resistant to ampicillin, amoxicillin and piperacillin without inhibitors. Tests based on a chromogenic cephalosporin can be used to detect the beta-lactamase.

^{11/} Most *M. catarrhalis* produce beta-lactamase, although beta-lactamase production is slow and may give weak results with in vitro tests. Beta-lactamase producers should be reported resistant to penicillins and aminopenicillins without inhibitors.

^{12/} Always test for beta-lactamase (tests based on a chromogenic cephalosporin can be used). If beta-lactamase positive, report resistant to ampicillin and amoxicillin. If beta-lactamase negative, determine the MIC of benzylpenicillin. Infer the susceptibility to ampicillin and amoxicillin from the benzylpenicillin MIC (do not report benzylpenicillin susceptibility).

^{13/} Infer susceptibility from ampicillin susceptibility

^{14/} Susceptibility can be inferred from benzylpenicillin susceptibility

The prevalence of resistance may vary geographically and with time for selected species, and local information on resistance is desirable, particularly when treating severe infections. As necessary, expert advice should be sought when the local prevalence of resistance is such that the utility of the agent in at least some types of infections is questionable.

***In vitro* susceptibility of micro-organisms to Amoxicillin**

Commonly Susceptible Species

Gram-positive aerobes:

Enterococcus faecalis

Beta-hemolytic streptococci (Groups A, B, C and G)

Listeria monocytogenes

Species for which acquired resistance may be a problem

Gram-negative aerobes: *Escherichia coli*

Haemophilus influenzae

Helicobacter pylori

Proteus mirabilis

Salmonella typhi

Salmonella paratyphi

Pasteurella multocida

Gram-positive aerobes:

Coagulase negative staphylococcus

Staphylococcus aureus

Streptococcus pneumoniae

Viridans group streptococcus

Gram-positive anaerobes: <i>Clostridium</i> spp.
Gram-negative anaerobes: <i>Fusobacterium</i> spp.
Other: <i>Borrelia burgdorferi</i>
Inherently resistant organisms†
Gram-positive aerobes: <i>Enterococcus faecium</i> ‡
Gram-negative aerobes: <i>Acinetobacter</i> spp. <i>Enterobacter</i> spp. <i>Klebsiella</i> spp. <i>Pseudomonas</i> spp.
Gram-negative anaerobes: <i>Bacteroides</i> spp. (many strains of <i>Bacteroides fragilis</i> are resistant).
Others: <i>Chlamydia</i> spp. <i>Mycoplasma</i> spp. <i>Legionella</i> spp.
†Natural intermediate susceptibility in the absence of acquired mechanism of resistance. ‡Almost all <i>S.aureus</i> are resistant to amoxicillin due to production of penicillinase. In addition, all methicillin-resistant strains are resistant to amoxicillin.

5.2 Pharmacokinetic properties

The pharmacokinetic results for studies in which amoxicillin was administered to groups of healthy volunteers given as a bolus intravenous injection are presented below.

Mean pharmacokinetic parameters <i>Bolus intravenous injection</i>

Dose administered				
	Peak serum conc ($\mu\text{g/ml}$)	T $\frac{1}{2}$ (h)	AUC ($\mu\text{g.h/ml}$)	Urinary recovery (% , 0 to 6h)
500 mg	32.2	1.07	25.5	66.5
1000 mg	105.4	0.9	76.3	77.4

About 18% of total plasma amoxicillin is bound to protein and the apparent volume of distribution is around 0.3 to 0.4 l/kg.

Following intravenous administration, amoxicillin has been found in gall bladder, abdominal tissue, skin, fat, muscle tissues, synovial and peritoneal fluids, bile and pus. Amoxicillin does not adequately distribute into the cerebrospinal fluid.

From animal studies there is no evidence for significant tissue retention of drug-derived material. Amoxicillin, like most penicillins, can be detected in breast milk (see section 4.6).

Biotransformation

Amoxicillin is partly excreted in the urine as the inactive penicilloic acid in quantities equivalent to up to 10 to 25% of the initial dose.

Elimination

The major route of elimination for amoxicillin is via the kidney

Amoxicillin has a mean elimination half-life of approximately one hour and a mean total clearance of approximately 25 l/hour in healthy subjects. Approximately 60 to 70% of the amoxicillin is excreted unchanged in urine during the first 6 hours after administration of a single 250 mg or 500 dose of amoxicillin. Various studies have found the urinary excretion to be 50 to 85% for amoxicillin over a 24 hours period.

Concomitant use of probenecid delays amoxicillin excretion (see section 4.5).

Gender

Following oral administration of amoxicillin to healthy males and female subjects, gender has no significant impact on the pharmacokinetics of amoxicillin.

Age

The elimination half-life of amoxicillin is similar for children aged around 3 months to 2 years and older children and adults. For very young children (including preterm newborns) in the first week of life the interval of administration should not exceed twice daily administration due to immaturity of the renal pathway of elimination. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and it may be useful to monitor renal function.

Renal impairment

The total serum clearance of amoxicillin decreases proportionately with decreasing renal function (see section 4.2).

Hepatic impairment

Hepatically impaired patients should be dosed with caution and hepatic function monitored at regular intervals.

5.3 Preclinical safety data

Non-clinical data reveal no special hazard for humans based on studies of safety pharmacology, repeated dose toxicity, genotoxicity and toxicity to reproduction and development.

Carcinogenicity studies have not been conducted with amoxicillin.

6 PHARMACEUTICAL PARTICULARS

6.1 List of excipients

None.

6.2 Incompatibilities

This medicinal product must not be mixed with other medicinal products except those mentioned in section 6.6.

Amoxicillin should not be mixed with blood products, other proteinaceous fluids such as protein hydrolysates or with intravenous lipid emulsions. If prescribed concomitantly with an aminoglycoside, the antibiotics should not be mixed in the syringe, intravenous fluid container or giving set because of loss of activity of the aminoglycoside under these conditions.

Amoxicillin solutions should not be mixed with infusions containing dextran or bicarbonate.

6.3 Shelf life

3 years.

Reconstituted vials (for intravenous injection or before dilution for infusion), see section 6.6.

From a microbiological point of view, the reconstituted and diluted solution should be used immediately.

6.4 Special precautions for storage

No special precautions for storage

6.5 Nature and contents of container

Vials containing 1g of amoxicillin sodium for injection are packaged in single packs or in packs of 10.

6.6 Special precautions for disposal

Do not use the solvent intended for the intramuscular route intravenously.
Any residual antibiotic solution should be discarded.
For single use only.

Intravenous administration

Vial	Diluent (ml)
1 g	20

Water for injection is the normal diluent.
Administer within 30 minutes of reconstitution.

All solutions should be shaken vigorously before injection.
Preparation of intravenous infusions and stability: add without delay the reconstituted solution of 1 g (as prepared above) to 100 ml infusion fluid (e.g. using a mini bag or in-line burette).

Intravenous amoxicillin may be given in a range of different intravenous fluids:

- Water for injection,
- Sodium chloride 0.9%
- Ringer NaCl
- Ringer Sodium Lactate
- Glucose 5%

Intramuscular administration

Vial	Diluent
1 g	2.5 ml Lidocaine hydrochloride solution

The maximum single dose is 1 g.

All solutions should be shaken vigorously before injection and administered immediately after reconstitution.

Any residual antibiotic solution should be discarded.

For single use only.

The volume of displacement :

Vial of Amoxicillin	Diluent water for injection (mL)	Final volume after reconstitution (mL)	Displacement volume (mL)
1g	20	20.7	0.7

Vial of Amoxicillin	Diluent lidocaine hydrochloride mL)	Final volume after reconstitution (mL)	Displacement volume (mL)
1g	2.5	3.3	0.8

7 MARKETING AUTHORISATION HOLDER

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