

# Summary of Product Characteristics

## 1 NAME OF THE MEDICINAL PRODUCT

Co-amoxiclav 2000 mg/200 mg powder for solution for infusion

## 2 QUALITATIVE AND QUANTITATIVE COMPOSITION

Each vial contains 2000 mg amoxicillin (as amoxicillin sodium) and 200 mg clavulanic acid (as potassium clavulanate)

Each vial contains 5.5 mmol (125.9 mg) of sodium

Each vial contains 1 mmol (39.3 mg) of potassium

## 3 PHARMACEUTICAL FORM

Powder for solution for infusion

White powder

## 4 CLINICAL PARTICULARS

### 4.1 Therapeutic indications

Co-amoxiclav 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 (adequately diagnosed)
- community acquired pneumonia
- cystitis
- pyelonephritis
- skin and soft tissue infections in particular cellulitis, animal bites, severe dental abscess with spreading cellulitis
- bone and joint infections, in particular osteomyelitis
- intra-abdominal infections
- female genital infections

Prophylaxis against infections associated with major surgical procedures in adults, such as those involving the:

- gastrointestinal tract
- pelvic cavity
- head and neck
- biliary tract surgery

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

### 4.2 Posology and method of administration

#### Posology

Doses are expressed throughout in terms of amoxicillin/clavulanic acid content except when doses are stated in terms of an individual component.

The dose of amoxicillin/clavulanic acid 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 use of alternative presentations of amoxicillin/clavulanic acid (e.g. those that provide higher doses of amoxicillin and/or different ratios of amoxicillin to clavulanic acid) should be considered as necessary (see sections 4.4 and 5.1).

This powder for solution for infusion provides a total daily dose of 6000 mg amoxicillin and 600 mg clavulanic acid when administered as recommended below. If it is considered that a higher daily dose of amoxicillin is required, this must not be achieved by increasing the Co-amoxiclav dose. This is in order to avoid administration of unnecessarily high daily doses of clavulanic acid.

The duration of therapy should be determined by the response of the patient. Some infections (e.g. osteomyelitis) require longer periods of treatment. Treatment should not be extended beyond 14 days without review (see section 4.4 regarding prolonged therapy).

Consideration should be given to local guidelines on appropriate dosing frequencies for amoxicillin/clavulanic acid.

Adults and children ≥ 40 kg

For treatment of infections as indicated in section 4.1:

- amoxicillin/clavulanic acid 1000 mg/100 mg every 8 hours - 12 hours
- amoxicillin/clavulanic acid 2000 mg/ 200 mg every 12 hours

For very severe infections the dose can be increased to a maximum of 2000 mg/200 mg every 8 hour.

For surgical prophylaxis	<p>For procedures less than 1 hour in duration, the recommended dose of amoxicillin/clavulanic acid is 1000 mg/100 mg to 2000 mg/200 mg given at induction of anaesthesia</p> <p>For procedures greater than 1 hour in duration, the recommended dose of amoxicillin/clavulanic acids 1000 mg/100 mg to 2000 mg/200 mg given at induction of anaesthesia, with up to 3 doses of 1000 mg/100 mg in 24 hours.</p> <p>Clear clinical signs of infection at operation will require a normal course of intravenous or oral therapy post-operatively.</p>
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Children < 40 kg

Recommended doses:

- Children aged 3 months and over: 50 mg/5 mg per kg every 8 hours
- Children aged less than 3 months or weighing less than 4 kg: 50 mg/5 mg per kg every 12 hours

Elderly

No dose adjustment is considered necessary.

Renal impairment

Dose adjustments are based on the maximum recommended level of amoxicillin.

No dose adjustment is required in patients with creatinine clearance (CrCl) greater than 30 ml/min.

Co-amoxiclavmg/200 mg should only be used in patients with a creatinine clearance (CrCl) of less than 30 ml / min for surgical prophylaxis when used in one infusion.

Hepatic impairment

Dose with caution and monitor hepatic function at regular intervals (see sections 4.3 and 4.4).

Method of administration

Co-amoxiclav is for intravenous use.

Co-amoxiclav 2000 mg/200 mg should be administered by intravenous infusion over 30 to 40 min. Co-amoxiclav 2000 mg/200 mg is not suitable for intramuscular administration.

Children aged less than 3 months should be administered Co-amoxiclav by infusion only.

Treatment with amoxicillin/clavulanic acid may be initiated by the use of an intravenous preparation and completed with an appropriate oral presentation as considered appropriate for the individual patient.

For instructions on reconstitution and dilution of the medicinal product before administration, see section 6.6.

### 4.3 Contraindications

- Hypersensitivity to the active substances or to penicillins
- History of a severe immediate hypersensitivity reaction (e.g. anaphylaxis) to another beta-lactam agent (e.g. a cephalosporin, carbapenem or monobactam)
- History of jaundice/hepatic impairment due to amoxicillin/clavulanic acid (see section 4.8).

### 4.4 Special warnings and precautions for use

Before initiating therapy with amoxicillin/clavulanic acid, 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/ clavulanic acid therapy must be discontinued, and appropriate alternative therapy instituted.

Drug-induced enterocolitis syndrome (DIES) has been reported mainly in children receiving amoxicillin/clavulanate (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.

In the case that an infection is proven to be due to an amoxicillin-susceptible organisms(s) then consideration should be given to switching from amoxicillin/clavulanic acid to amoxicillin in accordance with official guidance.

This presentation of Co-amoxiclav may not be suitable for use when there is a high risk that the presumptive pathogens have resistance to beta-lactam agents that is not mediated by beta-lactamases susceptible to inhibition by clavulanic acid. As no specific data for  $T > MIC$  are available and the data for comparable oral presentations are borderline, this presentation (without additional amoxicillin) may not be suitable for the treatment of penicillin-resistant *S. pneumoniae*. For coverage of this pathogen, a dose of at least 2000 mg/200 mg every 12 hours is required.

Convulsions may occur in patients with impaired renal function or in those receiving high doses (see section 4.8).

Amoxicillin/clavulanic acid 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.

Concomitant use of allopurinol during treatment with amoxicillin can increase the likelihood of allergic skin reactions.

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

The occurrence at the treatment initiation of a feverish generalised erythema associated with pustula may be a symptom of acute generalised exanthemous pustulosis (AGEP) (see section 4.8). This reaction requires amoxicillin/clavulanic acid discontinuation and contraindicates any subsequent administration of amoxicillin.

Amoxicillin/clavulanic acid should be used with caution in patients with evidence of hepatic impairment (see sections 4.2, 4.3 and 4.8).

Hepatic events have been reported predominantly in males and elderly patients and may be associated with prolonged treatment. These events have been very rarely reported in children. In all populations, signs and symptoms usually occur during or shortly after treatment but in some cases, may not become apparent until several weeks after treatment has ceased. These are usually reversible. Hepatic events may be severe and in extremely rare circumstances, deaths have been reported. These have almost always occurred in patients with serious underlying disease or taking concomitant medications known to have the potential for hepatic effects (see section 4.8).

Antibiotic-associated colitis has been reported with nearly all antibacterial agents including amoxicillin 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/ clavulanic acid should immediately be discontinued, a physician be consulted, and an appropriate therapy initiated. Anti-peristaltic medicinal products are contra-indicated in this situation.

Periodic assessment of organ system functions, including renal, hepatic and haematopoietic function is advisable during prolonged therapy.

Prolongation of prothrombin time has been reported rarely in patients receiving amoxicillin/ clavulanic acid. 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 sections 4.5 and 4.8).

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

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 section 4.8 and 4.9).

During treatment with amoxicillin, enzymatic glucose oxidase methods should be used whenever testing for the presence of glucose in urine because false positive results may occur with non-enzymatic methods.

The presence of clavulanic acid in Co-amoxiclav may cause a non-specific binding of IgG and albumin by red cell membranes leading to a false positive Coombs test.

There have been reports of positive test results using the Bio-Rad Laboratories Platelia *Aspergillus* EIA test in patients receiving amoxicillin/clavulanic acid who were subsequently found to be free of *Aspergillus* infection. Cross-reactions with non-*Aspergillus* polysaccharides and polyfuranoses with Bio-Rad Laboratories Platelia *Aspergillus* EIA test have been reported. Therefore, positive test results in patients receiving amoxicillin/clavulanic acid should be interpreted cautiously and confirmed by other diagnostic methods.

This medicinal product contains 125.9 mg sodium per vial, equivalent to 6.29% of the WHO recommended maximum daily intake of 2 g sodium for an adult.

This medicinal product contains 39.3 mg (1 mmol) of potassium per vial. To be taken into consideration by patients with reduced kidney function or patients on a controlled potassium diet.

#### **4.5 Interaction with other medicinal products and other forms of interaction**

##### 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 co-administration 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.

##### 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 but not of clavulanic acid.

##### Mycophenolate mofetil

In patients receiving mycophenolate mofetil, reduction in pre-dose concentration of the active metabolite mycophenolic acid (MPA) of approximately 50% has been reported following commencement of oral amoxicillin plus clavulanic acid. The change in pre-dose level may not accurately represent changes in overall MPA exposure. Therefore, a change in the dose of

mycophenolate mofetil should not normally be necessary in the absence of clinical evidence of graft dysfunction. However, close clinical monitoring should be performed during the combination and shortly after antibiotic treatment.

#### 4.6 Fertility, pregnancy and lactation

##### Pregnancy

Animal studies do not indicate direct or indirect harmful effects with respect to pregnancy, embryonal/foetal development, parturition or postnatal development (see section 5.3). Limited data on the use of amoxicillin/clavulanic acid during pregnancy in humans do not indicate an increased risk of congenital malformations. In a single study in women with preterm, premature rupture of the foetal membrane it was reported that prophylactic treatment with amoxicillin/clavulanic acid may be associated with an increased risk of necrotising enterocolitis in neonates. Use should be avoided during pregnancy, unless considered essential by the physician.

##### Breast-feeding

Both substances are excreted into breast milk (nothing is known of the effects of clavulanic acid on the breast-fed infant).

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. The possibility of sensitisation should be taken into account. Co-amoxiclav should only be used during breast-feeding after benefit/risk assessment by the physician in charge.

#### 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 vomiting.

The ADRs derived from clinical studies and post-marketing surveillance with amoxicillin/clavulanic acid, sorted 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)

MedDRA System Organ Class	Frequency	Undesirable Effects
<b>Infections and infestations</b>	Common	Mucocutaneous candidosis
	Not known	Overgrowth of non-susceptible organisms
<b>Blood and lymphatic system disorders</b>	Rare	Reversible leucopenia (including neutropenia) Thrombocytopenia
	Not known	Reversible agranulocytosis Haemolytic anaemia Prolongation of bleeding time and prothrombin time <sup>1</sup>
<b>Immune system disorders</b> <sup>10</sup>	Not known	Angioneurotic oedema Anaphylaxis Serum sickness-like syndrome Hypersensitivity vasculitis
<b>Nervous system disorders</b>	Uncommon	Dizziness Headache
	Not known	Convulsions <sup>2</sup>

		Aseptic meningitis
<b>Vascular disorders</b>	Rare	Thrombophlebitis <sup>3</sup>
<b>Cardiac disorders</b>	Not known	Kounis syndrome
<b>Gastrointestinal disorders</b>	Common	Diarrhoea
	Uncommon	Nausea Vomiting Indigestion
	Not known	Antibiotic associated colitis <sup>4</sup> Drug-induced enterocolitis syndrome Pancreatitis acute
<b>Hepatobiliary disorders</b>	Uncommon	Rises in AST and/or ALT <sup>5</sup>
	Not known	Hepatitis <sup>6</sup> Cholestatic jaundice <sup>6</sup>
<b>Skin and subcutaneous tissue disorders<sup>7</sup></b>	Uncommon	Skin rash Pruritus Urticaria
	Rare	Erythema multiforme
	Not known	Stevens-Johnson syndrome Toxic epidermal necrolysis Bullous exfoliative-dermatitis Acute generalised exanthemous pustulosis (AGEP) <sup>9</sup> Drug reaction with eosinophilia and systemic symptoms (DRESS) Linear IgA disease
<b>Renal and urinary disorders</b>	Not known	Interstitial nephritis Crystalluria <sup>8</sup> (including acute renal injury)

<sup>1</sup> See section 4.4<sup>2</sup> See section 4.4<sup>3</sup> At the site of injection<sup>4</sup> Including pseudomembranous colitis and haemorrhagic colitis (see section 4.4)<sup>5</sup> A moderate rise in AST and/or ALT has been noted in patients treated with beta-lactam class antibiotics, but the significance of these findings is unknown.<sup>6</sup> These events have been noted with other penicillins and cephalosporins (see section 4.4).<sup>7</sup> If any hypersensitivity dermatitis reaction occurs, treatment should be discontinued (see section 4.4).<sup>8</sup> See section 4.9<sup>9</sup> See section 4.4<sup>10</sup> See sections 4.3 and 4.4

#### 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 HPRC Pharmacovigilance, Earlsfort Terrace, IRL - Dublin 2; Tel: +353 1 6764971; Fax: +353 1 6762517. Website: [www.hpra.ie](http://www.hpra.ie); E-mail: [medsafety@hpra.ie](mailto:medsafety@hpra.ie).

#### **4.9 Overdose**

##### Symptoms and signs of overdose

Gastrointestinal symptoms and disturbance of the fluid and electrolyte balances may be evident. Amoxicillin crystalluria, in some cases leading to renal failure, has been observed (see section 4.4).

Convulsions may occur in patients with impaired renal function or in those receiving high doses.

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/clavulanic acid can be removed from the circulation by haemodialysis.

## 5 PHARMACOLOGICAL PROPERTIES

### 5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Antibacterials for systemic use; Combinations of penicillins, incl. beta-lactamase inhibitors

ATC code: J01CR02

#### 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.

Clavulanic acid is a beta-lactam structurally related to penicillins. It inactivates some beta-lactamase enzymes thereby preventing inactivation of amoxicillin. Clavulanic acid alone does not exert a clinically useful antibacterial effect.

#### 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 two main mechanisms of resistance to amoxicillin/clavulanic acid are:

- inactivation by those bacterial beta-lactamases that are not themselves inhibited by clavulanic acid, including class B, C and D
- 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.  
Breakpoints MIC breakpoints for amoxicillin/clavulanic acid are those of the European Committee on Antimicrobial Susceptibility Testing (EUCAST)

Organism	Susceptibility Breakpoints (mg/L)	
	Susceptible	Resistant
<i>Haemophilus influenzae</i>	≤ 2 <sup>1</sup>	> 2 <sup>1</sup>
<i>Moraxella catarrhalis</i>	≤ 1 <sup>1</sup>	> 1 <sup>1</sup>
<i>Staphylococcus</i> spp.	Note <sup>2,3,4</sup>	Note <sup>2,3,4</sup>
<i>Enterococcus</i> spp. <sup>5</sup>	≤ 4 <sup>1,6</sup>	> 8 <sup>1,6</sup>
<i>Streptococcus</i> groups A, B, C, G <sup>7</sup>	Note <sup>8</sup>	Note <sup>8</sup>
<i>Streptococcus pneumoniae</i> <sup>7</sup>	Note <sup>9,10</sup>	Note <sup>9,10</sup>
Viridans group streptococci <sup>7</sup>	Note <sup>11-12</sup>	Note <sup>11-12</sup>
Enterobacterales <sup>13</sup> (uncomplicated UTI only)	≤ 8 <sup>1</sup> (≤ 32 <sup>1</sup> )	> 8 <sup>1</sup> (> 32 <sup>1</sup> )

Gram-negative Anaerobes	$\leq 4^1$	$> 8^1$
Gram-positive Anaerobes	$\leq 4^1$	$> 8^1$
<i>Pasteurella multocida</i>	$\leq 1^1$	$> 1^1$
<i>Burkholderia pseudomallei</i>	$\leq 0.001^1$	$> 8^1$
<i>Kingella Kingae</i>	Note <sup>14</sup>	Note <sup>14</sup>
Non-species related breakpoints	$\leq 2^1$	$> 8^1$

<sup>1</sup> For susceptibility testing purposes, the concentration of clavulanic acid is fixed at 2 mg/l.

<sup>2</sup> 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 ceftiofur can be reported susceptible to all penicillins. Isolates that test resistant to benzylpenicillin but susceptible to ceftiofur are susceptible to  $\beta$ -lactam  $\beta$ -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 ceftiofur are resistant to all penicillins.

<sup>3</sup> 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 coagulase-negative staphylococci but methicillin resistance can be detected with ceftiofur as described.

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

<sup>5</sup> Aminopenicillin breakpoints in enterococci are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only

<sup>6</sup> 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*.

<sup>7</sup> The addition of a beta-lactamase inhibitor does not add clinical benefit.

<sup>8</sup> 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.

<sup>9</sup> The oxacillin 1 microg disk screen test or a benzylpenicillin MIC test shall be used to exclude beta-lactam resistance mechanisms.

<sup>10</sup> Susceptibility inferred from ampicillin (indications other than meningitis).

<sup>11</sup> Benzylpenicillin (MIC or disk diffusion) can be used to screen for beta-lactam resistance in viridans group streptococci. Isolates categorised as screen negative can be reported susceptible to beta-lactam agents for which clinical breakpoints are listed (including those with "Note"). Isolates categorised as screen positive should be



tested for susceptibility to individual agents.

<sup>12</sup>For benzylpenicillin screen negative isolates (inhibition zone  $\geq 18$  mm or MIC  $\leq 0.25$  mg/L), susceptibility can be inferred from benzylpenicillin or ampicillin. For benzylpenicillin screen positive isolates (inhibition zone  $< 18$  mm or MIC  $> 0.25$  mg/L), susceptibility is inferred from ampicillin.

<sup>13</sup>Aminopenicillin breakpoints in *Enterobacteriales* are based on intravenous administration. For oral administration the breakpoints are relevant for urinary tract infections only. Breakpoints for other infections are under review.

<sup>14</sup> The intrinsic activity of clavulanic acid in *K. kingae* is such that the organism is inhibited by 2 mg/L clavulanic acid. Therefore no breakpoints for amoxicillin-clavulanic acid can be given.

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.

### **Commonly susceptible species**

#### **Aerobic Gram-positive micro-organisms**

*Enterococcus faecalis*

*Gardnerella vaginalis*

*Staphylococcus aureus* (methicillin-susceptible) £

Coagulase-negative staphylococci (methicillin-susceptible)

*Streptococcus agalactiae*

*Streptococcus pneumoniae*<sup>1</sup>

*Streptococcus pyogenes* and other beta-haemolytic streptococci

*Streptococcus viridans* group

#### **Aerobic Gram-negative micro-organisms**

*Actinobacillus actinomycetemcomitans*

*Capnocytophaga* spp.

*Eikenella corrodens*

*Haemophilus influenzae*<sup>2</sup>

*Moraxella catarrhalis*

*Neisseria gonorrhoeae*§

*Pasteurella multocida*

#### **Anaerobic micro-organisms**

*Bacteroides fragilis*

*Fusobacterium nucleatum*

*Prevotella* spp.

### **Species for which acquired resistance may be a problem**

#### **Aerobic Gram-positive micro-organisms**

*Enterococcus faecium* §

#### **Aerobic Gram-negative micro-organisms**

*Escherichia coli*

*Klebsiella oxytoca*

*Klebsiella pneumoniae*

*Proteus mirabilis*

*Proteus vulgaris*

#### **Inherently resistant organisms**

#### **Aerobic Gram-negative micro-organisms**

*Acinetobacter* sp.

*Citrobacter freundii*  
*Enterobacter* sp.  
*Legionella pneumophila*  
*Morganella morganii*  
*Providencia* spp.  
*Pseudomonas* sp.  
*Serratia* sp.  
*Stenotrophomonas maltophilia*

Other micro-organisms  
*Chlamydia trachomatis*  
*Chlamydophila pneumoniae*  
*Chlamydophila psittaci*  
*Coxiella burnetti*  
*Mycoplasma pneumoniae*

§ Natural intermediate susceptibility in the absence of acquired mechanism of resistance.

£ All methicillin-resistant staphylococci are resistant to amoxicillin/clavulanic acid.

§ All strains with resistance to amoxicillin that is not mediated by beta-lactamases are resistant to amoxicillin/clavulanic acid.

<sup>1</sup> This presentation of amoxicillin/clavulanic acid may not be suitable for treatment of *Streptococcus pneumoniae* that are resistant to penicillin (see sections 4.2 and 4.4).

<sup>2</sup> Strains with decreased susceptibility have been reported in some countries in the EU with a frequency higher than 10%.

## 5.2 Pharmacokinetic properties

### Absorption

The pharmacokinetic results for studies in which amoxicillin/clavulanic acid was administered to groups of healthy volunteers as 2000 mg/200 mg given as an intravenous infusion over 30 min are presented below.

Mean ( $\pm$  SD) pharmacokinetic parameters

#### *Intravenous infusion over 30 min*

Dose administered	Amoxicillin				
	Dose	Mean peak serum conc. (microg/ml)	T 1/2 (h)	AUC (h.mg/l)	Urinary recovery (%; 0 to 6 h)
AMX/CA 2000 mg/200 mg	2000 mg	108 $\pm$ 21		119 $\pm$ 10,6	74,7
Clavulanic acid					
AMX/CA 2000 mg/200 mg	200 mg	13,9 $\pm$ 2,8		18,2 $\pm$ 3,0	51,4

AMX – amoxicillin, CA – clavulanic acid

### Distribution

About 25% of total plasma clavulanic acid and 18% of total plasma amoxicillin is bound to protein. The apparent volume of distribution is around 0.3-0.4 l/kg for amoxicillin and around 0.2 l/kg for clavulanic acid.

Following intravenous administration, both amoxicillin and clavulanic acid have 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 for either component. Amoxicillin, like most penicillins, can be detected in breast milk. Trace quantities of clavulanic acid can also be detected in breast milk (see section 4.6).

Both amoxicillin and clavulanic acid have been shown to cross the placental barrier (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. Clavulanic acid is extensively metabolized in man, and eliminated in urine and faeces and as carbon dioxide in expired air.

#### Elimination

The major route of elimination for amoxicillin is via the kidney, whereas for clavulanic acid it is by both renal and non-renal mechanisms.

Amoxicillin and clavulanic acid have a mean elimination half-life of approximately one hour and a mean total clearance of approximately 25 l/h in healthy subjects. Approximately 60 to 70% of the amoxicillin and approximately 40 to 65% of the clavulanic acid are excreted unchanged in urine during the first 6 h after administration of a single 500/100 mg or a single 1000/200 mg bolus intravenous injection. Various studies have found the urinary excretion to be 50-85% for amoxicillin and between 27-60% for clavulanic acid over a 24 hour period. In the case of clavulanic acid, the largest amount of drug is excreted during the first 2 hours after administration.

Concomitant use of probenecid delays amoxicillin excretion but does not delay renal excretion of clavulanic acid (see section 4.5).

#### 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/clavulanic acid decreases proportionately with decreasing renal function. The reduction in drug clearance is more pronounced for amoxicillin than for clavulanic acid, as a higher proportion of amoxicillin is excreted *via* the renal route. Doses in renal impairment must therefore prevent undue accumulation of amoxicillin while maintaining adequate levels of clavulanic acid (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**

Nonclinical data reveal no special hazard for humans based on studies of safety pharmacology, genotoxicity and toxicity to reproduction.

Repeat dose toxicity studies performed in dogs with amoxicillin/clavulanic acid demonstrate gastric irritancy and vomiting, and discoloured tongue.

Carcinogenicity studies have not been conducted with amoxicillin/clavulanic acid or its components.

## **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. Co-amoxiclav 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 loss of activity of the aminoglycoside can occur under these conditions. Co-amoxiclav solutions should not be mixed with infusion solutions containing glucose, dextran or bicarbonate.

### **6.3 Shelf life**

2 years

**Shelf-life after dilution or reconstitution**Reconstituted vials (before dilution for infusion)

The reconstituted solution (1 vial in 20 mL of water for injection) should be further diluted immediately.

Reconstituted and diluted solution (for intravenous infusion)

Chemical and physical in-use stability has been demonstrated after reconstitution and further dilution to 100 mL as shown in the following table:

<b>Infusion Fluid</b>	<b>Hours (25°C)</b>
Water for Injection	1
Sodium Chloride Intravenous Infusion 0.9%	1
Ringer Solution	1
Hartmann's Solution; Ringer-Lactate Solution	1
Potassium Chloride 0.3% - Sodium Chloride 0.9% solution for infusion	1

From a microbiological point of view, unless the method of opening/reconstitution/dilution precludes the risk of microbial contamination, the product should be used immediately. If not used, immediately, in-use storage times and conditions are the responsibility of the user and would not be longer than the times stated above for the chemical and physical in-use stability.

**6.4 Special precautions for storage**

Do not store above 25°C.

For storage conditions after reconstitution and dilution of the medicinal product, see section 6.3.

**6.5 Nature and contents of container**

Clear glass vial (Ph.Eur. Type III) fitted with a chlorobutyl rubber stopper and an aluminium ring.

Pack sizes: 1 or 10 vials in a cardboard box.

Not all pack sizes may be marketed.

**6.6 Special precautions for disposal and other handling**

For single use only. Any unused solution should be discarded.

Reconstitution/dilution must be performed under aseptic conditions. The solution must be visually inspected for particulates and discolouration prior to administration. The solution should only be used if it is clear and free of particles.

Any unused product or waste material should be disposed of in accordance with local requirements.

Preparation of solutions for intravenous injection

Water for Injection Ph. Eur. is the normal solvent.

Co-amoxiclav 2000/200 mg should be dissolved in 20 ml of solvent. This yields approximately 21.4 ml of solution for single-dose use.

A transient pink colouration may or may not develop during reconstitution.

Reconstituted solutions are normally colourless or a pale straw colour.

Preparation of solutions for intravenous infusion

Co-amoxiclav vials are not suitable for multi-dose use.

Co-amoxiclav 2000/200 mg should be reconstituted as described above. Without delay the reconstituted solution should be diluted to at least 100 ml of infusion fluid using a minibag or in-line burette.

Intravenous infusions of Co-amoxiclav may be administered with the following infusion fluids.

**Compatible diluents**

Water for injections Ph.Eur.

Sodium chloride 9 mg/ml (0.9%) solution for infusion

Ringer Solution

Hartmann's Solution; Ringer-Lactate Solution

Sufficient antibiotic concentrations are obtained at room temperature (25 ° C) in the recommended volume of the above infusion fluids for the times stated in section 6.3. After reconstitution, dilution and storage at room temperature (25 ° C), infusions should be completed within the time indicated in the table in section 6.3.

The stability of Co-amoxiclav solutions for intravenous use is concentration-dependent. If more concentrated solutions are required, the stability periods should be adjusted accordingly.

Co-amoxiclav for intravenous use is less stable in infusions containing glucose, dextran or bicarbonate. Reconstituted solutions of Co-amoxiclav should therefore not be premixed with such infusions but can be injected into the infusion tube over a period of 3 to 4 minutes.

**7 MARKETING AUTHORISATION HOLDER**

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