IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

BG RCI
Berufsgenossenschaft
Rohstoffe und chemische Industrie

Bundesministerium
für Arbeit und Soziales

Escherichia coli (other strains)

GENERAL INFORMATION

Escherichia coli (other strains)

For further information on the current nomenclature of the species see
List of Prokaryotic names with Standing in Nomenclature

Escherichia coli (Migula 1895) Castellani and Chalmers 1919, species. (Type species of the genus). Family of Enterobacteriaceae within the group of gammaproteobacteria, genus *Escherichia*.

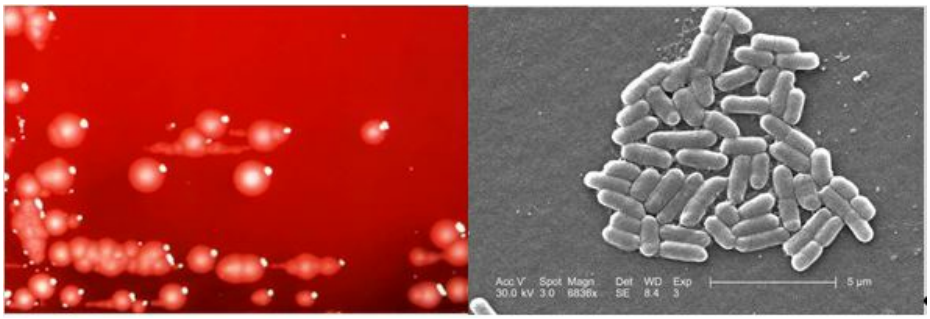
Etymology: Latin from colon or colum, the intestine; Latin gen. from coli, of the intestine.

Document Number:	822327
Processing status:	This information was compiled on 17.12.2019. It was revised on 02.09.2021.
Category:	Bacteria
Strain type:	ATCC 11775 = CCUG 24 = CCUG 29300 = CIP 54.8 = DSM 30083 = JCM 1649 = LMG 2092 = NBRC 102203 = NCCB 54008 = NCTC 9001. Further information: BacDive - The Bacterial Diversity Metadatabase (DSMZ)
Risk group:	2 Biological agents that can cause human disease and might be a hazard to employees; they are unlikely to spread to the comunity; there is usually effective prophylaxis or treatment available.
References:	Note TA: Types of which strains are known which have been handled safely over many years in technical applications. These proven strains can therefore be assigned to risk group 1 according to the classification criteria. The "TA" tag lays no claim of completeness, however. Strains with the features of "TA" may therefore also arise in species not bearing this tag. Note ht: Pathogenic for humans and vertebrates, but normally no transmission between the two host groups.

Consultant / Reference laboratory:

For the field of human medicine, only one consultant laboratory is available for Shiga toxin-forming *E. coli* (EHEC, synonym STEC, VTEC) (refer to the datasheet on enterohaemorrhagic E. coli).

In the fields of veterinary medicine and foods:
National Veterinary Reference Laboratory for *Escherichia coli*, including verotoxigenic *E. coli* (EHEC, VTEC)
Federal Risk Assessment Institute [Bundesinstitut für Risikobewertung (BfR)]
Diedersdorfer Weg 1
12277 Berlin, Germany
E-mail: VTEC@bfr.bund.de
Contact: Dr Niels Bandick (Manager)
Phone: 030-18412-24100
E-mail: Niels.Bandick@bfr.bund.de



Right: *E. coli* Colonies on blood agar
Left: electron micrograph (scanning) of *E. coli*
Source: CDC Public Health Image Library (PHIL)

Medical significance

Intestinal bacteria of the species *Escherichia coli (E. coli)* are generally harmless and constitute an important part of the natural bacterial intestinal flora. Acquisition of virulence factors results in pathogenic subtypes (pathovars). Shiga toxin or verotoxigenic *E. coli* strains (EHEC, VTEC, STEC), which may cause severe intestinal infections and renal damage (HUS syndrome) particularly in young children, are the best known pathovars (see the separate datasheet on enterohaemorrhagic *E. coli* /EHEC). *E. coli* that form toxins other than Shiga toxins are referred to as ETEC (enterotoxic *E. coli*). ETEC are one of the most significant causes of traveller's diarrhoea.
Aside from toxinogenic *E. coli*, however, there are a number of other pathovars that do not produce toxins (Shiga toxins, other enterotoxins) but have other pathogenic properties.

- Subtypes that trigger intestinal infections (gastroenteritis) are summarised under the term of enteropathogenic *E. coli* (EPEC). EPEC is one of the most important global bacterial diarrhoeal pathogens in infants and children; it may cause persistent diarrhoea in adults.

- *E. coli* that trigger infections other than diarrhoea (such as urinary tract or wound infections) are referred to as extraintestinally pathogenic *E. coli* (ExPEC).

Other subtypes that are named by their pathogenic properties exist within these two groups (EPEC and ExPEC). EPEC that are able to penetrate the intestinal epithelium are called enteroinvasive *E. coli* (EIEC); those that adhere to the intestinal epithelium and form cell aggregates are referred to as enteroaggregative (EAggEC) *E. coli*. If the ability to form cell aggregates is lacking, they are called diffusely adherent *E. coli* (DAEC). EPEC are also classified into typical (tEPEC) and atypical (aEPEC) *E. coli*, which differ in terms of their virulence properties and distribution.
The course of the disease varies depending on the pathovar. Whilst EIEC trigger disease with a course comparable to shigellosis, EAggEC often cause chronic (persistent) diarrhoeal diseases.

Extraintestinal *E. coli* (Expec):
Aside from intestinal infections, E. coli may trigger various other infections. *E. coli* most commonly cause urinary tract infections (uropathogenic *E. coli*; UPEC), generally consisting of ascending infections (that is, from the perineum via the urethra). If *E. coli* enter the kidneys, pyelitis may result. *E. coli* may also cause prostate inflammation. *E. coli* strains that contain the polysaccharide K1 may cause inflammation of the meninges (neonatal meningitis) in neonates, with significant complications. Wound infections and lung infections are less common. If *E. coli* enters the bloodstream, it may cause blood poisoning (sepsis).

Reference: 24996 25008 25010 25011

Transmission routes

EPEC is generally transmitted by the faecal-oral route. EPEC may be transmitted by contaminated (dirty) drinking water or bath water, consumption of contaminated foods or as a human to human contact infection (for example, in case of insufficient hand hygiene after using toilets). The risk of contagion exists as long as these bacteria are excreted.

Reference: 24993 99999

For further information on transmission routes see chapter EPIDEMIOLOGY.

OCCUPATIONAL SAFETY AND HEALTH

Sector | Activity | Protective measures | Inactivation/Decontamination | Immediate measures/First aid | Occupational health care

SECTORS

- Healthcare,
- research facilities,
- laboratories,
- paediatrics,
- preschool childcare,
- communal kitchens,
- water procurement,
- water supply,
- wastewater disposal,
- sewage sludge recycling,
- work stays in endemic regions,
- veterinary medicine

Reference: 99999

ACTIVITIES

- Activities in wastewater treatment systems
- activities in healthcare/social care
- activities in microbiological laboratories
- activities in food processing facilities
- activities in restaurant facilities
- tasting raw preparations

Reference: 99999

PROTECTIVE MEASURES

General protective measures

The pathogen is primarily transmitted by the oral infection route (intake via the mouth). Strict compliance with hygiene regulations (especially the hand disinfection plan) must be ensured. A lab coat and gloves must be worn as minimum protection. Pay attention to changing gloves.
In countries with a low hygiene status, raw foods should not be consumed and bathing in public bodies of water should be avoided. Strict hand hygiene must be ensured, especially after using toilets.

The following protective measures apply to specific activities in laboratories, the husbandry of laboratory animals and biotechnological activities. For further information see TRBA 100, TRBA 120, TRBA 500.

Technical measures

Where tasks intentionally involve biomaterials, their identity must be verified and documented routinely.
Areas in which the biomaterial is processed must be isolated from other areas and labelled with the 'Biohazard' warning symbol and protection level **2**.
The doors of the area within which the protection level applies must open in the direction of the escape route and be equipped with an inspection window.
Where a health hazard posed by bioaerosols cannot be eliminated, the relevant activities must be performed in a microbiological safety cabinet (MSC). For detailed information on activities in MSCs, see leaflet B 011 of the BG RCI (German Social Accident Insurance Institution for the raw materials and chemical industry).
Wash basins, disinfectant dispensers, disposable towels and hand detergents must be available.
Water faucets and disinfectant dispensers must be operable without the use of the hands.
Laboratories must offer suitable eyewash facilities.
All surfaces and areas that could come into contact with biological agents must be easy to clean, liquid-tight and resistant to detergents and disinfectants. A seamless wall-floor joint must be effected.
Windows and doors must be kept closed while work is in progress.
Work areas are to be maintained in a clean and tidy state. Only tools and devices that are actually needed may remain on the benches.
Pipettors must be provided and used. Mouth pipetting is not permitted.
If the use of pointed or sharp instruments cannot be avoided, they must be disposed of in suitable containers after use.
The release of biological agents must be minimised during the opening of technical equipment.
Catch basins must be in place to ensure that open sample containers are prevented from turning over during work operations.
The biomaterial must not be stored under conditions that favour its reproduction.
Clearly labelled, closed, rigid, liquid-tight and unbreakable vessels that can be disinfected from the outside must be provided and used for the in-house transport of biological agents.
Transport of biological agents outside the plant is subject to the regulations governing hazardous goods (class 6.2).
Suitable containers must be available for the collection of waste that constitutes biological agents.

Organisational measures

The number of staff must be limited to the actual requirements, and access to the area in which the protection level applies must be restricted to authorized persons.
An instruction manual must be prepared. Prior to beginning their activity and subsequently at least once a year, verbal and work-related instruction must be provided to staff members to familiarise them with the hazards and protective measures as laid down in the instruction manual. DGUV Informative Publication 213-016 (BGI/GUV-I 853) contains a prototype instruction manual on 'activities involving biological agents of Risk Group 2' in accordance with the German Ordinance on Biological Substances.
The instruction process must also include advice in occupational medicine and safety.
Restrictions of employment for expectant and nursing mothers must be observed in accordance with the German Maternity Protection Act.
Injuries must be reported immediately to the person in charge.

Personal protection - body protection

Suitable protective clothing must be worn (at least lab coats).
Durind the processing of infectious tissues, the protective clothing must be complemented by disposable aprons.
Remove protective clothing when leaving the area in which the protection level applies.
Keep protective clothing separate from normal clothing.

Personal protection - hand protection

Depending on the results of the risk assessment, the use of protective gloves may be mandatory for certain activities.
The skin protection plan must be observed.

Personal protection – eye and face protection

Depending on the results of the risk assessment, protective goggles or face protection may be necessary.

Personal protection - respiratory protection

It is generally not necessary to wear respiratory safety equipment.

Occupational hygiene

The consumption and storage of food and alcohol/tobacco in the protection level area is forbidden.
The wearing of jewellery, watches and rings on the hands and the forearms is not permitted. Fingernails are to be kept short.
Following completion of work and prior to leaving the work area, hands are to be disinfected, washed and remoisturised according to the skin protection plan.
Skin protection and skin care agents must be made available in contamination-proof containers.
Contaminated protective clothing and shoes are to be collected safely and decontaminated, cleaned and disposed of centrally.
Work clothing must not be cleaned at home.
The cleaning regulations for employees, equipment and workplaces must be defined in a hygiene plan.
Insects and pests in the working area must be regularly controlled.

Vaccination

No approved vaccine is available.

Reference: 00001 99999

INACTIVATION / DECONTAMINATION

Disinfection measures must be carried out by proven means and procedures. For detailed information see the following lists: DVG - Animal Husbandry (German Association for Veterinary Medicine, Accommodation and Husbandry of Animals), DVG - Food Area, VAH and RKI. Officially ordered disinfection measures (decontamination) required by the authorities may be carried out only with disinfection agents included in the RKI list.
Furthermore, the Industrie Association Hyhiene and Surface Protection (IHO) supplies lists of statements of companies on the efficacy of different products. The information in this register is based on statments of the respective companies.
A suitable autoclave must be available in the same building.
Externally contaminated test vessels must be disinfected before opening.
Work areas and working equipment must be decontaminated before the performance of maintenance measures. For further information see TRBA 100 (‘Technical Rules for Biological Agents’).
Contaminated solid wastes, liquid cultures and suspensions containing pathogens are to be collected in appropriate containers and deactivated.

Reference: 00001

IMMEDIATE MEASURES / FIRST AID / POST-EXPOSURE PROPHYLAXIS

Accidental release measures

Separate the contaminated area and initiate disinfection measures according to the hygiene plan or standard operating procedures. If swallowed, perform an immediate antiseptic rinse of the oral cavity. Post-exposure prophylaxis with antibiotics is not indicated. The patient should be advised regarding potential symptoms.

First aid: eyes and mucous membranes

Wash the eyes with an eye shower or eye wash bottle for 10 - 15 minutes while keeping the eyelids open. Consult a physician.

First aid: skin

Skin disinfection according to the hygiene plan. Consult a physician.

First aid: respiratory tract

There is a risk of infection through inhalation of infectious aerosols, as the possibility of the pathogen being absorbed through the oral cavity and subsequently swallowed cannot be ruled out. Thorough antiseptic mouth rinsing, spit out, do not swallow! The rinsing water is considered contaminated and must be collected and decontaminated. Seek medical advice.

First aid: swallowing

Oral intake is the primary route of infection. Thoroughly rinse the mouth with antiseptic mouthwash; spit out, do not swallow! Consult the accident insurance consultant.

Information for physicians

Enteropathogenic *E. coli* are common triggers of enteritis, however they do not need to be included in basic diagnostics due to their low clinical relevance. Current guidelines do not recommend antibiotic treatment when EPEC is confirmed. Symptomatic diarrhoea treatment by fluid and electrolyte substitution as needed and administration of spasmolytics in case of abdominal cramps is the primary focus. Fluid and electrolyte loss may rapidly become life-threatening, especially in infants and young children.
Laboratory confirmation of intestinally pathogenic *Escherichia coli* is reportable pursuant to the Infectious Diseases Act (§ 7 Para. 1 No. 13 b of the Infectious Diseases Act) if it indicates an acute infection.

Reference: 10305 10307 99999

OCCUPATIONAL HEALTH CARE according to ArbMedVV

Optional health care:
In the case of tasks specifically involving contact and tasks involving incidental contact with biological agents classed as Risk Group 2 under the Biological Agents Ordinance (Biostoffverordnung, BioStoffV) or which involve a comparable risk, the employer must offer an optional health care. This does not apply when on account of the risk assessment and on account of the protective measures taken it can be assumed that there is no risk of infection.
An optional health care must also be offered if as a result of the exposure to biological agents
- a serious infectious illness is to be expected and post-exposure prophylatic measures are possible, or
- an infection has resulted.

MORPHOLOGY AND PHYSIOLOGY

MORPHOLOGY

E. coli is a Gram-negative rod bacillus measuring approximately 1.1 - 1.5 µm in diameter with a length of approximately 2.0 - 6.0 µm. Cells are generally motile and have peritrichous flagella. They may form capsules and fimbria.

Reference: 99999

PHYSIOLOGY

These bacteria are facultatively anaerobic, oxidase-negative and catalase-positive. Pathogenic*E. coli* strains such as EPEC produce various additional virulence factors that are responsible for their pathogenic properties. A main attribute of all EPEC is the ability to bind to the intestinal wall (intestinal epithelium) and injure it, finally destroying the microvilli (a process referred to as "attaching and effacing" (AE) histopathology). This requires various virulence genes that are located on a pathogenicity islet which is integrated into the chromosome and approximately 35 kilo base pairs in size, also referred to as the "locus of enterocyte effacement (LEE)". The intimin plays a significant role as a virulence factor for adhesion to the intestinal epithelium. Unlike EHEC, no Shiga toxins are formed. Additional virulence factors are present depending on the pathovar. For example, enteroinvasive *E. coli* have an additional gene (ipaA-H) which facilitates penetration into/through the intestinal wall. Enteroaggregative E. coli have genes that let it form complex cell aggregates (aggregative adherence (AA)). Aside from this, there are various other virulence factors that are responsible for the specific properties of a pathovar. Virulence genes are often located on additional DNA elements (plasmids) that can be transferred to other E. coli by gene transfers. Differences in virulence markers permit identification at the pathovar level. For example, EIEC may be definitively identified by detecting the ipaH gene.

Reference: 24993 24994 24996 25007 25010 99999

INFORMATION ON MOLECULAR BIOLOGY

Genome
The genomes of several EPEC strains have been sequenced, and are available in databases such as EMBL or GenBank. The average size of the genome is 5 mega base pairs (5 million base pairs). Extrachromosomal DNA (plasmids) that commonly bear virulence factors may be present.
The genome of the EPEC strain E2348/69 (O127:H6) consists of one chromosome and 2 plasmids, and can be accessed under accession number GCA_000026545.1.

Comments

Diagnostics/identification: Definitive identification of an *E. coli* isolate as a typical EPEC is performed by PCR by detecting the intimin gene (eaeA) and the EPEC adherence factor-coding gene (EAF) which is located on a plasmid, with simultaneous negative findings for Shiga toxin genes stx1 and stx2. EIEC can be identified by confirming the ipaH gene (invasion plasmid antigen H gene).

Reference: 10309 24993 25010 99999

OCCURRENCE / NATURAL HABITAT

FREE-LIVING / HOST BOUND

This biological agent is host-dependent parasitical.
This biological agent is host dependent-commensalic.

Generally host-bound as a pathogen (parasitic) or as a colonising agent of the digestive tract in various vertebrates (saprophytic/commensal); however, longer survival in the environment is possible in wet areas (such as bodies of water contaminated by faecal matter). Longer survival on various foods (potentially including reproduction) is also possible under suitable conditions.
Reference: 24993 99999

HOSTS

Humans, various animal species.
Reference: 99999

VECTORS

Primarily humans themselves (especially asymptomatic excretors). Various animal species (mammals, birds) are reservoirs of EPEC; animal-to-human transmission via excretions is probable.
Reference: 24993 24999 25000 25001 99999

GEOGRAPHIC DISTRIBUTION

Pathogenic *E. coli* are distributed globally, especially in West and Central Africa and South Asia (India).
Reference: 24996 99999

PATHOGENICITY / PATHOGENIC PROPERTIES

CHARACTERISTIC OF PATHOGENICITY

Human-pathogenic (causes diseases in humans).
Animal-pathogenic (causes diseases in animals).

Pathogenic to humans and various vertebrates such as cattle, pigs, domestic cats, and poultry. Young children and elderly individuals are especially affected. Contact with the pathogen does not result in clinically manifest illness in every case. Humans and animals may excrete pathogenic *E. coli* without any visible signs of disease. Taking proton pump inhibitors (gastric acid inhibitors) favours the development of clinically manifest *E. coli* infections in humans (this applies to all diarrhoeal pathogens).
Reference: 24993 24995 99999

MINIMUM INFECTIOUS DOSE (MID)

Unlike EHEC, approximately 108 to 1010 bacteria are required to trigger disease in healthy adults (volunteer study). The infectious dose for naturally acquired infections is unknown. It is assumed that the infectious dose is significantly lower in children aged under two years.
Reference: 24997 24998 25010 99999

CARCINOGENICITY / MUTAGENICITY / REPRODUCTIVE TOXICITY

No information is available about this.

Reference: 99999

ALLERGENICITY / SENSITISING EFFECT

An allergic / sensitising potential is not known.

No allergenic or sensitising effects are known.
Reference: 99999

TOXIGENICITY / TOXIN FORMATION

Unlike enterohaemorrhagic *E. coli* (EHEC, VTEC, STEC), other *E. coli* do not produce cytotoxins (Shiga toxins).
Nonetheless, various other pathovars (especially including ETEC, EaggEC) form heat-resistant enterotoxins (EAST) whose role in diarrhoeal diseases is not yet fully explained.
Reference: 25010 99999

DISEASE

DESCRIPTION

Depending on the clinical picture, such as:
E. coli-related diarrhoeal disease (gastroenteritis)
E. coli-related urinary tract infection
E. coli-related meningitis
E. coli-related sepsis
E. coli-related wound infection
Reference: 99999

ZOONOSIS

Zoonosis (transmission between animals and humans): Yes

Animal to human transmission is possible in principle. However, humans are the primary (or sole) known reservoir for typical EPEC and EIEC. The extent to which animal to human transmission plays a role is unclear.
Reference: 25000 25001 99999

INFECTIOUS STAGES

All stages must be regarded as infectious.
Reference: 99999

INCUBATION PERIOD

The WHO states an incubation period of 1 - 6 days, although it may be only a few hours in isolated cases.
Reference: 25006 99999

SYMPTOMS AND COURSE OF DISEASE

Infections caused by pathogenic *E. coli* may take an asymptomatic course or trigger various courses of illness depending on the pathovar involved. Intestinally pathogenic *E. coli* (EPEC, EaggEC, EIEC) produce diarrhoeal diseases. Extraintestinal *E. coli* may trigger various forms of illness depending on the entry point and pathovar (urinary tract infections, pyelitis, meningitis, appendicitis, peritonitis, wound infections, sepsis).
Infections due to EPEC primarily manifest as acute, watery diarrhoea (usually young children aged < 2 years). However, adults may develop persistent diarrhoeal disease lasting for several weeks. Enteroaggregative EC generally trigger persistent diarrhoeal disease. Infections with EIEC may manifest similar to EPEC infections or additionally trigger bloody, mucous diarrhoeal disease (dysentery).
Aside from severe watery diarrhoea, vomiting and mild fever are common symptoms of EPEC infections. EPEC infections may generally take a severe course, requiring weeks to months of hospital stays.

Reference: 24996 24999 25006 25009 25010 99999

LETHALITY

Lethality rates are low with good medical care. However, mortality rates of up to 70% were observed in infants and young children during various outbreaks in developing countries.

Reference: 24999 25010

THERAPY

For treatment, it is necessary to differentiate between *E. coli*-related diarrhoeal diseases and extraintestinal infections. In *E.coli*-related diarrhoeal diseases, the greatest danger and majority of complications results from severe fluid loss. Treatment is therefore primarily symptomatic (compensate fluid and electrolyte loss) and aims to relieve symptoms. Treatment with antibiotics is not generally indicated, but may be given in individual cases.
Other infections caused by *E. coli* are generally treated with antibiotics. Due to the frequently acquired multiresistance, antibiotics have to be specifically applied after careful evaluation.

Reference: 99999

PROPHYLAXIS

The most important measure consists of washing hands after using toilets and before handling foods. Raw foods must be stored under sufficiently refrigerated conditions. Young children should only be given foods that were previously peeled or thoroughly washed. Water should be sufficiently boiled for infants. Isolation of diseased individuals plays a major role in hospitals, as well as thorough disinfection of hand contact surfaces.

Reference: 99999

EPIDEMIOLOGY

TRANSMISSION ROUTES / PORTALS OF ENTRY

Transmission takes place percutaneously (through the skin).
Transmission takes place orally (by ingestion).

The main transmission route of enteropathogenic *E. coli* is by the faecal-oral route, either from human to human or via foods or bodies of water contaminated by faecal matter.
Extraintestinal *E. coli* may also penetrate through injured skin.

Reference: 24993 99999

PATHOGEN RESERVOIR

The main transmission route of enteropathogenic *E. coli* is by the faecal-oral route, either from human to human or via foods or bodies of water contaminated by faecal matter.
Extraintestinal *E. coli* may also penetrate through injured skin.

Reference: 24993 99999

INCIDENCE

EPEC infections are the most common bacterial diarrhoeal diseases in young children (‹ 5 years) in developing countries. EPEC infections have been significantly subsiding in the industrial nations since the 1940s and 50s.

Despite the disease being reportable, the precise numbers of diarrhoeal disease cases caused by *E. coli* (other than EHEC) in Germany cannot be stated. Further differentiation at the pathovar level is often not performed as part of the diagnostics. In an evaluation of the surveillance system for other intestinally pathogenic *Escherichia coli* performed by the Robert Koch Institute in 2013, a total of 4000 cases of intestinal disease due to non-toxin-forming *E. coli* were registered in Bavaria in the period between 2007 and 2019.

Reference: 10307 24996 25009 99999

RESISTANCE / TENACITY

SPORULATION

Does not form spores.

Reference: 99999

CONIDIA FORMATION

Does not form conidia.

Reference: 99999

RESISTANCES

Multiple resistances to antibiotics are observed frequently. However, since treatment with antibiotics plays virtually no role in the treatment of *E. coli*-related diarrhoeal disease, the development of antibiotic resistances is secondary.
This is unlike infections with extraintestinal *E. coli*, especially in meningitis, sepsis or urinary tract infection, which are generally treated with antibiotics. Here, the development of resistances, also to reserve antibiotics such as colistin, is alarming.

Reference: 25002 25003 25004 25005

LEGAL PRINCIPLES / REGULATIONS

LAWS AND ORDINANCES

Ordinance on Safety and Health Protection at Workplaces Involving Biological Agents (Biological Agents Ordinance - BioStoffV)

Law for the regulation of genetic engineering (Genetic Engineering Act -GenTG) and associated regulations (only in German).

Public notice of the list risk-rated donor organisms and recipient organisms for genetic engineering of 5. July 2013

Law on the prevention and control of infectious diseases in humans (Infection Protection Act -IfSG) (only in German)

Ordinance on Occupational Health Care (ArbMedVV)

Law for the protection of working mothers (MuSchG)
(only in German)

Animal health law (TierGesG) and associated regulations (only in German)

Rules for transportation of dangerous goods:
- European Convention on the carriage of dangerous goods by road (ADR)
- Order concerning the International Carriage of Dangerous Goods by Rail (RID)
- International Air Transport Association (IATA), dangerous goods regulation, 54th edition 2013
- the law on the transport of dangerous goods (Gefahrgutbeförderungsgesetz". -GGBefG)
- Regulation on the national and international transport of dangerous goods by road, rail and inland waterway services (Dangerous Goods Regulations, road, rail and inland waterways - GGVSEB)
- Regulation on the International Maritime Dangerous Goods (Dangerous Goods Regulations lake - GGVSee)
- Regulation on the order of advisor and the training of the persons in businesses and enterprises (Dangerous Goods Advisor Ordinance - GBV) (only in German)

Regulation to protect against hazardous substances (Hazardous Substance Ordinance -GefStoffV) (only in German)

TECHNICAL RULES AND OTHER REGULATIONS

TRBA 100
Protective measures for activities involving biological agents in laboratories

TRBA 250
Biological agents in health care and welfare facilities

TRBA 400
Guideline for risk assessment and for the instruction of employees in relation to activities with biological agents

TRBA 450
Criteria for the classification of biological agents

TRBA 466
Classification of prokaryotes (bacteria and archaea) into risk groups (only in German)

TRBA 500
Basic measures to be taken for activities involving biological agents

LINKS

Public Health Agency of Canada (PHAC)

Information provided by the Public Health Agency of Canada for this pathogen

Further Links:

CABI - Invasive Species Compendium, Datasheet to this pathogen
CABI - Invasive Species Compendium, Datasheet to this pathogen
CABI - Invasive Species Compendium, Datasheet to this pathogen
CABI - Invasive Species Compendium, Datasheet to this pathogen
Information provided by the Bayerischen Landesamt für Gesundheit und Lebensmittelsicherheit (Bavarian State Office for Health and Food Safety)
Information provided by the Center for Food Safety and Public Health, Iowa State University
Information provided by the U.S. Food and Drug Administration
Compendium of Measures to Prevent Disease Associated with Animals in Public Settings

REFERENCES

General information | Occupational and health protection | Morphology and physiology | Occurrence/natural habitat | Pathogenicity/pathogenic properties | Disease | Epidemiology | Resistance/Tenacity | Legal basics | Links | References

Quelle: 00001
Informationen aus den Technischen Regeln für Biologische Arbeitsstoffe, insbesondere aus:
Information from the technical rules for biological substances, in particular from:
- TRBA 100
Schutzmaßnahmen für Tätigkeiten mit biologischen Arbeitsstoffen in Laboratorien; Ausgabe: Oktober 2013, geändert 2014
Protective measures for activities involving biological agents in laboratories; Edition: October 2013, amended 2014
- TRBA 120
Versuchstierhaltung; Ausgabe: Juli 2012, geändert 2017
Experimental animal husbandry; Edition July 2012, amended 2017
- TRBA 500
Grundlegende Maßnahmen bei Tätigkeiten mit biologischen Arbeitsstoffen; Ausgabe: April 2012
Basic measures to be taken for activities involving biological agents; Edition April 2012

Quelle: 01466
TRBA 466
Einstufung von Prokaryonten (Bacteria und Archaea) in Risikogruppen; Ausgabe: August 2015, zuletzt geändert: GMBl. Nr. 25-31 vom 14. August 2019, S. 478
Classification of prokaryotes (bacteria and archaea) in risk groups; Edition August 2015, last amended August 2019

Quelle: 02014
Verordnung zur arbeitsmedizinischen Vorsorge (ArbMedVV)
Ordinance on Occupational Health Care (ArbMedVV)

Quelle: 10305
AWMF online: Leitline-Detailansicht, Gastrointestinale Infektionen und Morbus Whipple (2015)
https://www.awmf.org/leitlinien/detail/ll/021-024.html

Quelle: 10307
Robert Koch-Institut: Evaluation des Surveillancesystems für sonstige darmpathogene *Escherichia coli*. (2013)
https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2013/20/Art_01.html

Quelle: 10309
Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit (LGL): Leitfaden Labordiagnostik von Shigatoxin-bildenden und anderen darmpathogenen Escherichia coli-Stämmen (2019):
https://www.lgl.bayern.de/downloads/gesundheit/infektionsschutz/doc/leitfaden_labordiagnostik.pdf

Quelle: 24993
Garcia Diez, Marta (2009) Vorkommen und Charakterisierung von enteropathogenen *Escherichia coli* Isolaten aus Lebensmitteln, Wasser und humanen Ursprungs. Inaugural-Dissertation zur Erlangung der tiermedizinischen Doktorwürde der Tierärztlichen Fakultät der Ludwig-Maximilians-Universität München.
https://edoc.ub.uni-muenchen.de/10622/

Quelle: 24994
Fernanda M. Franzin, and Marcelo P. Sircili (2015) Locus of Enterocyte Effacement: A Pathogenicity Island Involved in the Virulence of Enteropathogenic and Enterohemorragic *Escherichia coli* Subjected to a Complex Network of Gene Regulation. Biomed Res Int. 2015: 534738. doi: 10.1155/2015/534738

Quelle: 24995
Lilian Aparecida Sanches, et al. (2017) Captive wild birds as reservoirs of enteropathogenic *E. coli* (EPEC) and Shiga-toxin producing *E. coli* (STEC) Braz J Microbiol. 48(4): 760–763. doi: 10.1016/j.bjm.2017.03.003

Quelle: 24996
Croxen MA et al. (2013) Recent advances in understanding enteric pathogenic *Escherichia coli*. Clinical Microbiology Reviews 26, 822–880.

Quelle: 24997
Bieber D, Ramer SW, Wu CY, Murray WJ, Tobe T, Fernandez R, Schoolnik GK. (1998) Type IV pili, transient bacterial aggregates, and virulence of enteropathogenic *Escherichia coli*. Science 280:2114–2118.

Quelle: 24998
Levine MM, Bergquist EJ, Nalin DR, Waterman DH, Hornick RB, Young CR, Sotman S. (1978) *Escherichia coli* strains that cause diarrhea but do not produce heat-labile or heat-stable enterotoxins and are noninvasive. Lancet i:1119–1122.

Quelle: 24999
Levine MM, Edelman R. (1984) Enteropathogenic *Escherichia coli* of classic serotypes associated with infant diarrhea: epidemiology and pathogenesis. Epidemiol. Rev. 6:31–51

Quelle: 25000
Sekse C, Sunde M, Lindstedt B-A, Hopp P, Bruheim T, Cudjoe KS, Kvitle B, Urdahl AM. (2011) Potentially human-pathogenic *Escherichia coli* O26 in Norwegian sheep flocks. Appl. Environ. Microbiol. 77:4949–4958.

Quelle: 25001
Moura RA, Sircili MP, Leomil L, Matté MH, Trabulsi LR, Elias WP, Irino K, Pestana de Castro AF. (2009) Clonal relationship among atypical enteropathogenic *Escherichia coli* strains isolated from different animal species and humans. Appl. Environ. Microbiol. 75:7399–7408.

Quelle: 25002
Mediavilla JR, Patrawalla A, Chen L, Chavda KD, Mathema B, Vinnard C, Dever LL, Kreiswirth BN. (2016) Colistin- and carbapenem-resistant *Escherichia coli* harboring mcr-1 and blaNDM-5, causing a complicated urinary tract infection in a patient from the United States. mBio 7:e01191-16. doi:10.1128/mBio.01191-16.

Quelle: 25003
Schwarz S, Johnson AP (2016) Transferable resistance to colistin: a new but old threat. J Antimicrob Chemother 71:2066–2070. doi:10.1093/jac/dkw274.

Quelle: 25004
McGann P, Snesrud E, Maybank R, Corey B, Ong AC, Clifford R, Hinkle M, Whitman T, Lesho E, Schaecher KE (2016) *Escherichia coli* harboring mcr-1 and blaCTX-M on a novel IncF plasmid: first report of mcr-1 in the United States. Antimicrob Agents Chemother 60:4420–4421. doi:10.1128/AAC.01103-16.

Quelle: 25005
Yu H, Qu F, Shan B, Huang B, Jia W, Chen C, Li A, Miao M, Zhang X, Bao C, Xu Y, Chavda KD, Tang YW, Kreiswirth BN, Du H, Chen L. (2016) Detection of the mcr-1 colistin resistance gene in carbapenem-resistant Enterobacteriaceae from different hospitals in China. Antimicrob Agents Chemother 60:5033–5035. doi:10.1128/AAC.00440-16

Quelle: 25006
IHR News, The WHO quarterly bulletin on IHR implementation. (2008) WHO Foodborne disease outbreaks: Guidelines for investigation and control. World Health Organization; Geneva: 2008. p. 74.

Quelle: 25007
Parsot C (2005) *Shigella* spp. and enteroinvasive *Escherichia coli* pathogenicity factors. FEMS Microbiology Letters 252, 11–18.

Quelle: 25008
Kotloff KL et al. (2013) Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (The Global Enteric Multicenter Study, GEMS): a prospective, case-control study. The Lancet 382, 209–222.

Quelle: 25009
Ochoa TJ et al. (2008) New insights into the epidemiology of enteropathogenic *Escherichia coli* infections. Transactions of the Royal Society of Tropical Medicine and Hygiene 102, 852–856.

Quelle: 25010
Nataro JP, Kaper JB. Diarrheagenic *Escherichia coli*. (1998) Clin. Microbiol. Rev. 11:142–201.

Quelle: 25011
Trabulsi LR, Keller R, Tardelli Gomes TA. (2002) Typical and atypical enteropathogenic *Escherichia coli*. Emerg Infect Dis. 8:508–13.

Quelle: *99999*
Angabe des Bearbeiters
Indication of the author

General information | Occupational and health protection | Morphology and physiology | Occurrence/natural habitat | Pathogenicity/pathogenic properties | Disease | Epidemiology | Resistance/Tenacity | Legal basics | Links | References