

Measles virus

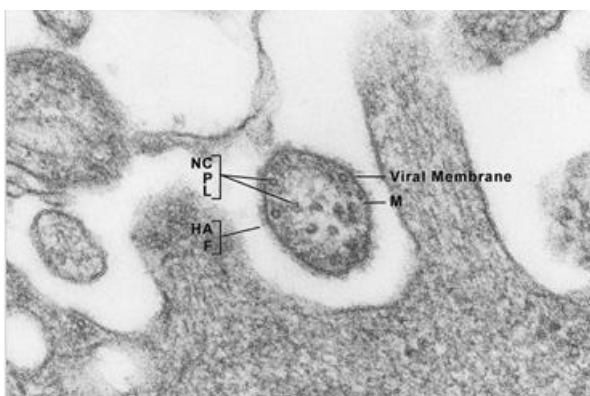
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GENERAL INFORMATION

Measles virus

MeV

Document Number:	830757
Processing status:	This information was compiled on 06.03.2014. This Information was revised on 05.06.2020.
Category:	Virus
Genus:	Morbillivirus
Risk group:	2 Biological agents that can cause human disease and might be a hazard to employees; they are unlikely to spread to the community; there is usually effective prophylaxis or treatment available.
References:	Note V: Effective vaccine available. The "V" tag has been adopted from Annex III of Directive 2000/54/EC.
Consultant / Reference laboratory:	National Reference Centre for Measles, Mumps, Rubella Robert-Koch Institute [Robert Koch-Institut], Seestraße 10, 13353 Berlin, Germany Head: Ms. PD Dr. A. Mankertz Tel.: +49 (0)30 - 18754-2516, - 23 08; Fax: +49 (0)30 - 18754-2598 E-mail: mankertza@rki.de



NC = Nucleocapsid; P = Phosphoprotein; L = Large protein;
HA = Hemagglutinin; F = Fusion protein; M = Matrix protein

This transmission electron microscopic (TEM) image revealed the ultrastructural appearance of a virus particle, or “virion”, of the measles virus. CDC/ Brian W.J. Mahy, BSc, MA, PhD, ScD, DSc
CDC Public Health Image Library (PHIL): <https://phil.cdc.gov/QuickSearch.aspx?key=true>

Medical significance

Measles could be a manageable disease which could even be eradicated, since an effective and tolerable vaccine is available since 1963, if only consistent blanket vaccination would take place. Due to the fact that specifically in Germany, certain population groups are tired of vaccination to some degree, however, there are repeated outbreaks which - due to the dramatic potential late sequelae of the measles virus infection - partly result in considerable lasting damage and even fatalities.

Suspected illness, disease and death due to measles viruses must be reported to the responsible health authorities; the same applies to direct or indirect detection of the microbe. Heads of community institutions (e.g. kindergartens and schools) must report cases of illness to the responsible health authorities.

If disease is suspected or confirmed, the affected person must not spend time in community institutions or work there.

The symptoms of an acute measles virus infection initially manifest themselves as fever, cough and malaise. In the further course of the disease, a typical skin rash and conjunctivitis develop. While the majority of infections heal without lasting consequences, neurological symptoms of encephalitis occur in rare cases, sometimes decades later and are usually fatal. Due to these severe complications, a measles virus infection is not a harmless childhood disease, contrary to what is often believed.

Reference: [04037](#)

Transmission routes

Transmission generally takes place by droplet infection or contact with nasal or pharyngeal secretions from diseased patients that contain the virus.

Admission over the respiratory tract.

Microbial contaminated aerosols (bioaerosols) are inhalable due to their size and can thus get in the lung.

Admission over the mouth.

A transmission takes place by touching the mouth with dirty hands or gloves or smoking without prior thorough cleaning of the hands (smear infection).

Special hazard exists in the case of contact with infected people and animals or their excretion.

Admission through the skin or the mucous membranes.

Splash in the eyes or mucous membranes of the mouth must be considered as portal of entry.

Reference: [04665](#)

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

- Health services
- Social paedagogy
- Childcare
- Laboratories

Reference: [04038](#) [10025](#)

ACTIVITIES

- Work involving contact with diseased persons, for example during health care
- Work involving contact with children who have no immune protection or whose vaccination status is unknown
- Contact with potentially contaminated materials, especially secretions of the upper airways

Reference: [04038 10025](#)

PROTECTIVE MEASURES

General protective measures

In non-specific activities involving contact with materials and fluids that may contain the virus (particularly including saliva from sick individuals), the required protection measures must be implemented and maintained based on the risk assessment. Individuals who are not vaccinated or whose antibody titre is unknown should catch up their vaccinations promptly. Precautions consisting of extended basic hygiene (e.g. careful hand disinfection, wearing disposable gloves and protective clothing) should be implemented in case of contact with individuals from the risk group. Thoroughly clean the used work equipment and all surfaces after all activities, using suitable disinfectants.

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.

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).

During 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

Depending on the results of the risk assessment, a respiratory protection device may be necessary.

Respiratory protection equipment must be worn for only a limited period of time. This period must be defined in the risk assessment.

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

Vaccines that have been used millions of times worldwide and whose safety and effectiveness have been proven many times over have been available since 1963. The vaccines are available as single vaccines or as combination vaccines with additional protection against mumps and rubella.

With the entry into force of the "Law for the Protection against Measles and for the Strengthening of Vaccination Prevention" on 01.03.2020, all persons born after 1970 who are cared for in a community institution or work in medical facilities are obliged to prove their immune protection against a measles virus infection.

Reference: [00001 02023 04037 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 Hygiene and Surface Protection ([HO](#)) supplies lists of statements of companies on the efficacy of different products. The information in this register is based on statements of the respective companies.

The enveloped particles of the measles virus are sensitive to disinfectants with limited virucidal activity. Efficient inactivation can be achieved, for example, by using 70% ethanol, 1% sodium hypochlorite, glutaraldehyde, hydrogen peroxide or peroxyacetic acid. Terralin PAA (8% solution, 60 min exposure time) is suitable for surface disinfection.

Sterillium Virugard (2 min exposure time) can be used for hand disinfection. In addition, heating to at least 56°C for 30 min or irradiation with UV radiation leads to inactivation of the measles virus particles.

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 04025 04665](#)

IMMEDIATE MEASURES / FIRST AID / POST-EXPOSURE PROPHYLAXIS

Accidental release measures

Immediately clear contaminated work areas and await sedimentation of any aerosols which may have formed; then put on protective wear and disinfect surfaces according to the hygiene plan (note exposure times). Respiratory protection masks (FFP3) are advised if it is suspected that larger quantities of the aerosol were released.

Absorb volumes of liquids with a universal binding agent (e.g. diatomite aka kieselguhr, sand), autoclave the resulting mixture, and then dispose of it as waste. Absorb smaller volumes of liquids with a disposable (hand) towel and dispose of it with contaminated waste, then disinfect the contaminated surfaces according to the hygiene plan.

First aid: eyes and mucous membranes

Wash the eye with opened lid for 10–15 minutes under running water, with an eye shower or ready-to-use eye wash solution (0.9% sterile sodium chloride solution). The washing liquid is potentially infectious and should therefore be decontaminated by autoclaving. If washing is performed under running water, it is generally unavoidable that the washing water will flow into the sewer system.

First aid: skin

Transmission via the skin is deemed improbable. If skin is accidentally contaminated, wet the area generously with a disposable cloth soaked in hand disinfectant. It is mandatory to comply with the specified exposure time. Apply the disinfectant repeatedly if the contaminated area is wet. Then thoroughly wash the affected skin area under running water.

First aid: respiratory tract

If aerosols that contain the virus are inhaled, thoroughly rinse the mouth and throat with water. Spit the water out, do not swallow it. Dispose of rinse water as contaminated liquid waste. It is recommended to consult with the accident insurance consultant or the responsible reference laboratory if the patient does not have antibodies to the measles virus as a result of previous immunization or having had the illness.

First aid: swallowing

Thoroughly rinse the mouth with water, spit out, do not swallow; dispose of rinse water as contaminated waste. Consult the accident insurance consultant or plant physician and discuss the further course of action with the reference laboratory if the patient cannot prove preceding immunization.

Information for physicians

Measles is reportable by name to the health authorities if illness is suspected or confirmed and in the event of measles-related fatalities. Direct and indirect confirmation of the infection are also reportable by name. The report must be submitted within 24 hours after the information becomes known.

Once the measles protection act was adopted, cases of subacute sclerosing panencephalitis also became reportable. Also, any doctor is permitted to administer the vaccine.

Reference: [04664 04681 99999](#)

OCCUPATIONAL HEALTH CARE according to [ArbMedVV](#)

Mandatory health care:

In the case of tasks specifically involving contact with the biological agent, a health care must be provided by the employer before commencement and then at regular intervals.

In the case of tasks involving incidental contact with the biological agent in research facilities or laboratories where regular activities which involve the possibility of coming into contact with infected or suspected samples, with infected or suspected animals, or objects or materials containing or contaminated with pathogens are carried out, the employer must provide a health care.

A health care must also be provided in the case of the following tasks involving incidental contact :

- In facilities for the medical examination, treatment or care of persons in the case of activities involving regular direct contact with sick or suspected persons.
- In facilities looking after pre-school children in the case of activities with regular, direct contact with children.

When finishing an activity for which mandatory health care had to be occasioned, the employer must offer optional health care.

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 prophylactic measures are possible, or
- an infection has resulted.

MORPHOLOGY AND PHYSIOLOGY

MORPHOLOGY

Measles viruses are enveloped viruses that measure approx. 120 to 140 nm in diameter and have a predominantly spherical morphology.

Reference: [04037 25178](#)

INFORMATION ON MOLECULAR BIOLOGY

Genome

The genome of measles viruses is made up of single-stranded RNA, which is present in negative orientation. It comprises approximately 16,000 nucleotides, is polyadenylated at the 3' terminus and has a cap structure at the 5' terminus. During infection, six structural proteins and two non-structural proteins are synthesized.

Reference: [04037 10330](#)

OCCURRENCE / NATURAL HABITAT

FREE-LIVING / HOST BOUND

This biological agent is host-dependent parasitical.

Reference: [04037](#)

HOSTS

Humans.

Reference: 04037

VECTORS

Transmission takes place from acutely ill persons who excrete the virus in their nasal and pharyngeal secretions.

Reference: 04664

GEOGRAPHIC DISTRIBUTION

Worldwide.

Reference: 04037

PATHOGENICITY / PATHOGENIC PROPERTIES

CHARACTERISTIC OF PATHOGENICITY

Human-pathogenic (causes diseases in humans).

Reference: 04037

MINIMUM INFECTIOUS DOSE (MID)

Measles virus results in infections even after brief contact. 95 % of unvaccinated persons exposed to the virus develop symptoms. At the same time, the minimum infectious dose that has to be transmitted in order to develop a disease is very low. In studies, 25 % to 50 % of children became ill when less than one infectious unit was administered intranasally.

Reference: 04037 25178

CARCINOGENICITY / MUTAGENICITY / REPRODUCTIVE TOXICITY

Carcinogenic or mutagenic effects are hitherto not known.

Reference: 99999

ALLERGENICITY / SENSITISING EFFECT

An allergic / sensitising potential is not known.

Reference: 04037

DISEASE

DESCRIPTION

Measles
Primary measles encephalitis
Acute postinfectious measles encephalitis
Subacute sclerosing panencephalitis (SSPE)

Reference: 99999

ZOONOSIS

Zoonosis (transmission between animals and humans): No

Dogs can be experimentally infected, but show no symptoms.

Reference: 04037

INCUBATION PERIOD

8 to 10 days until the onset of a cold-like disease stage. 14 to 21 days until the appearance of the typical cutaneous manifestations (exanthema).

Reference: [04037](#)

VIRAEMIA

Patients with acute measles virus infection are viraemic for about one week following onset of the characteristic skin rash. The highest viral burden is achieved after about 2 - 3 days, and the virus titre then drops again steeply within the following days.

Reference: [25052](#)

SYMPTOMS AND COURSE OF DISEASE

Measles virus infections progress in two phases: The onset is heralded by a runny nose, cough, sore throat, conjunctival inflammation, fever and rash in the mouth. White spots in the oral mucous membranes (Koplik spots) are a definite sign of measles virus.

Some days later, the characteristic skin rash (exanthema) forms, with pink-brown spots which run together. The rash first occurs behind the ears and on the face, and then spreads over the entire body. It persists for several days to one week and then heals; the skin often forms scales in this process.

Body temperature drops approximately at the time of healing. Following recovery from a measles virus infection, patients possess lifelong immunity.

Measles virus infection results in immune weakness persisting for approximately 6 weeks. This may result in bacterial superinfections such as middle ear inflammation, pneumonia and diarrhoea.

One of the most dangerous Measles virus complications is post-infectious encephalitis, a brain inflammation which occurs after Measles virus infections in approx. 0.1 % of cases. About four to seven days after the skin rash appears, this complication shows itself in the form of headache, fever altered consciousness and even ranging to coma. Approximately 10 to 20 % of affected persons die from it, while another 20 to 30 % suffer permanent brain damage.

A very rare late complication, subacute sclerosing panencephalitis (SSPE), may develop about 6 to 8 years, but in some cases only 15 years, after the measles virus infection. This brain inflammation occurs in approx. 1 to 10 cases per 10,000 to 100,000 Measles virus infections. Infections which occur in the first year of life are associated with a considerable higher risk of this late complication.

SSPE begins with changes in personality and intellect and progresses with neurological disturbances and deficiencies until loss of brain functions occurs. The course is invariably fatal.

Infected persons who still have maternal antibodies (newborns and breastfed babies), these who have received Measles virus specific antibodies, or whose vaccine antibodies do not (yet) provide complete protection experience a weakened disease progression in which the skin rash is not full-blown. This may make a clinical diagnosis more difficult, but these persons are nonetheless potential sources of infectious.

In the event that immunosuppression is present at the time of an infection, the resulting disease appears weak to an external observer; the skin rash may not appear at all or may be atypical.

Nevertheless, these cases may be accompanied by severe organ changes such as pneumonia and brain inflammation.

Reference: [04037 10331](#)

LETHALITY

Overall, one fatality per 10,000 to 20,000 measles virus infections must be expected. According to the Federal Statistics Office, there are 1 to 2 fatalities per year due to measles virus infections in Germany.

Reference: [04037](#)

THERAPY

Bedrest, symptomatic treatments; antibiotic treatment of secondary bacterial infections. There is no specific antiviral therapy.

Reference: [04037](#)

PROPHYLAXIS

Large-scale vaccination. Two vaccine doses are required to achieve sufficiently high antibody protection; the Standing Committee on Vaccination recommends that the first immunization should be given at the age of 11 - 14 months and the second vaccine dose at the age of 15 - 23 months. Since 01.03.2020, all individuals born after 1970 who receive care in public facilities, work in community institutions or work in medical facilities must prove that they have immune protection against measles virus infection. This also includes community housing for refugees and asylum applicants. The immune protection may be acquired by immunisations or by having recovered from measles illness.

Adults who are lacking one or both measles virus immunisations and are proven not to have had the illness can catch up the immunization at any age.

About 95% of the population must be vaccinated to prevent disease outbreaks and their spread in the population and thereby produce herd immunity.

Infected persons must not attend community institutions (schools, pre-schools).

Reference: [02023 04037](#)

EPIDEMIOLOGY

TRANSMISSION ROUTES / PORTALS OF ENTRY

Transmission takes place orally (by ingestion).

Droplet infection.

Reference: [04037](#)

PATHOGEN RESERVOIR

Infected and acutely diseased persons.

Reference: [04037](#)

INCIDENCE

Measles virus is found worldwide and causes large outbreaks with high caseloads and severe courses especially in Asia and Africa. A total of 543 new infections were documented in Germany in 2018.

Reference: [04662](#)

LEGAL PRINCIPLES / REGULATIONS

LAWS AND ORDINANCES

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

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 against measles and to strengthen vaccination prevention ([Measles Protection Act](#)) (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 462](#)

Classification of viruses into risk groups (only in German)

[TRBA 500](#)

Basic measures to be taken for activities involving biological agents

LINKS

European Centre for Disease Prevention and Control (ECDC)

[Information provided by the European Centre for Disease Prevention and Control for this pathogen](#)

Central Commission for Biological Security (ZKBS)

[Statement of the ZKBS on the risk assessment of recombinant measles vaccine strains](#)

Robert Koch Institute (RKI)

[Information provided by the Robert Koch Institute to this pathogen](#)

World Health Organization (WHO)

[Information provided by the World Health Organization to this pathogen](#)

[Information provided by the World Health Organization for this pathogen](#)

World Organisation for Animal Health (OIE)

[Information provided by the World Organisation for Animal Health](#)

Public Health Agency of Canada (PHAC)

[Information provided by the Public Health Agency of Canada for this pathogen](#)

[Information provided by the Public Health Agency of Canada for this pathogen](#)

Centers for Disease Control and Prevention (CDC)

[Information provided by the Centers for Disease Control and Prevention for Measles \(Rubeola\)](#)

[Information provided by the Centers for Disease Control and Prevention for this pathogen](#)

German Federal Institute for Occupational Safety and Health (BAuA)

[Epidemiology of work-related infectious diseases \(only in German\)](#)

European Association of Zoo and Wildlife Veterinarians (EAZWV)

[Information provided by the EAZWV \(European Association of Zoo and Wildlife Veterinarians\) for this pathogen](#)

Further Links:

[Information provided by the Bundeszentrale für gesundheitliche Aufklärung - BZgA \(Federal Center for Health Clarification\) for measles \(only in German\)](#)

REFERENCES

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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: 01462

[TRBA 462](#)

Einstufung von Viren in Risikogruppen; Ausgabe: April 2012

Classification of viruses in risk groups; Edition April 2012

Quelle: 02014

Verordnung zur arbeitsmedizinischen Vorsorge ([ArbMedVV](#))

Ordinance on Occupational Health Care ([ArbMedVV](#))

Quelle: 02023

Gesetz für den Schutz vor Masern und zur Stärkung der Impfprävention (Masernschutzgesetz), Bundesgesetzblatt, Teill Nr.6, Februar 2020

Quelle: 04025

Bekanntmachung des Robert Koch-Institutes: „Liste der vom Robert Koch-Institut geprüften und anerkannten Desinfektionsmittel und -verfahren“, Stand: 31. August 2013

Bundesgesundheitsbl. 2013 • 56:1706–1728

Quelle: 04037

Robert-Koch-Institut: „Ratgeber für Ärzte - Masern“, 2013

Quelle: 04038

Deutsche Gesetzliche Unfallversicherung, Bundesverband: „Information: Handlungsanleitung für die arbeitsmedizinische Vorsorge nach dem Berufsgenossenschaftlichen Grundsatz G 42 „Tätigkeiten mit Infektionsgefährdung“, 2010

Quelle: 04662

Robert-Koch-Institut: Infektionsepidemiologisches Jahrbuch meldepflichtiger Krankheiten für 2018

Quelle: 04664

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Quelle: 10025

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Quelle: 10330

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Quelle: 25178

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Quelle: 99999

Angabe des Bearbeiters
Indication of the author

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