Continue

Níveis de biossegurança 1

O ambiente laboratorial é carregado de riscos, tanto para os trabalhadores como para o meio ambiente. Diante disso, existe uma série de normas estabelecidas pela Agência Nacional de Vigilância Sanitária (Anvisa), a fim de minimizar os perigos. É extremamente importante que os laboratórios sigam tais critérios, pois a classificação baseada em níveis permite que as medidas de proteção sejam adotadas de acordo com os serviços de cada laboratório. Afinal, quais são as características de cada categoria? A seguir, explicaremos cada um dos 4 níveis de biossegurança determinados pela Anvisa na Resolução da Diretoria Colegiada (RDC) n° 50, além das práticas inerentes a cada um deles. Acompanhe! Classificação de acordo com níveis Em suma, a classificação em níveis de biossegurança baseia-se na análise de risco do agente infeccioso de maior periculosidade presente nas práticas de um laboratório. A partir dessa determinação, cada categoria apresenta critérios para: instalações do laboratório; manipulação dos experimentos; equipamentos de proteção individual (EPI) e coletiva. O objetivo de alinhar os cuidados é prevenir e minimizar os riscos que estão associados ao cotidiano daquele local. Seja com a finalidade de pesquisa, ensino e até processos produtivos, tanto o meio ambiente como os seres humanos devem ser preservados. As normas englobam 4 níveis, NB-1 a NB-4, aumentando a complexidade da proteção de modo crescente. É necessário determinar um responsável para avaliar em qual categoria o laboratório em questão será correspondente. Vale ressaltar a necessidade de apresentar instalações preconizadas pelas normas. Por isso, é importante ter noção de quais atividades serão realizadas no local para que seja devidamente arquitetado. Nível 1 de biossegurança (NB-1) É determinado para a manipulação de agentes da classe de risco 1, ou seja, microrganismos que têm baixa probabilidade de provocar doenças em seres humanos sadios ou animais. Logo na porta, é recomendado afixar um aviso de risco biológico. Por ser o nível de risco mais baixo, não são necessários equipamentos de proteção coletiva. Porém, é indispensável o uso de jaleco, luvas e touca para proteção individual. Complementando, não se deve tocar em maçanetas e interruptores quando calçado com luvas. Todos os colaboradores devem ser treinados para os procedimentos específicos do laboratório, supervisionados por um profissional com domínio em biossegurança, e ter o trabalho norteado pelas boas práticas laboratoriais. Elas incluem medidas simples, mas fundamentais para o dia a dia de um laboratório, como: evitar o uso de calçados abertos; não usar acessórios (anéis, relógios e pulseiras) durante as atividades laboratoriais; realizar lavagem de mãos; não comer, beber e/ou fumar; manter alimentos fora da área de trabalho; organizar um kit de primeiros socorros; possuir programa de controle de insetos e roedores; utilizar dispositivos mecânicos para a pipetagem, sendo proibido fazê-lo pela boca. Já em relação às barreiras de contenção secundária (instalações), são exigidas apenas bancadas abertas com pias próximas à saída. É preciso realizar a desinfecção das superfícies de trabalho ao final do uso ou quando houver contato direto de material viável. Nível 2 de biossegurança (NB-2) É adequado ao trabalho que envolve agentes com classe de risco 2, que são microrganismos que podem causar infecção, mas de tratamento fácil e eficaz — representando risco individual moderado e baixo para a comunidade. Neste nível, os trabalhos também envolvem a manipulação de sangue humano e fluidos corporais. A nível microscópico, contempla atividades nas quais a presença de agentes infecciosos é desconhecida em tecidos ou células humanos. Nesse caso, além dos EPIs necessários no nível 1, também é exigido o uso de máscara. Pensando na proteção coletiva, é determinada a utilização de cabines de classe I ou II, principalmente quando a manipulação de agentes aerossóis ou que provocam vazamentos de materiais infecciosos. Quanto às instalações, é necessário que as paredes, os tetos e os pisos sejam lisos, além de impermeáveis e resistentes à desinfecção. A autoclave também se torna um equipamento obrigatório, assim como o lava-olhos. No mais, alguns cuidados obrigatórios devem ser destacados: dispor de aviso de risco biológico; separar passagens públicas; não retirar lápis e canetas do local; separar o material cirúrgico; possuir precauções para objetos perfurocortantes; apresentar Manual de Biossegurança que defina qualquer descontaminação de dejetos ou normas de vigilância médica. Nível 3 de biossegurança (NB-3) É destinado ao trabalho com agentes de risco biológico de classe 3, potencialmente fatais, que apresentam elevado risco individual e baixo risco para a comunidade. Os equipamentos de segurança desse nível são semelhantes ao NB-2, acrescentando o uso das cabines de classe I ou II em todas as manipulações de agentes abertas. Além disso, é preciso destinar um local do laboratório para armazenar jalecos e EPIs exclusivos dele. Que a lavagem de mãos é indispensável, você já sabe, mas aqui passa a requerer uma torneira cujo acionamento não necessita do uso das mãos. Complementando, em vez de um par de luvas, passam a ser necessários dois, com os itens superpostos. As instalações seguem o NB-2, somados a separação física dos corredores de acesso, as portas duplas com fechamento automático, o ar de exaustão que não deve recircular e o fluxo negativo dentro do laboratório. No âmbito elétrico, um gerador passa a ser indispensável para situações de emergência. Já as superfícies devem ser vedadas. As práticas específicas são: apresentar acesso rigorosamente controlado; realizar desinfecção de todo o lixo, assim como a roupa usada no laboratório antes de ser lavada; coletar e armazenar amostra sorológica de cada colaborador exposto ao risco como referência. Nível 4 de biossegurança (NB-4) É referente a laboratórios em que os colaboradores estão expostos a agentes altamente patogênicos, de fácil propagação, que não possuem medidas terapêuticas ou profiláticas, representando um elevado risco individual e para a comunidade. Consequentemente, todos os procedimentos devem ser realizados dentro de cabine classe III ou em cabines de classe I ou II, juntamente ao uso do macacão de pressão positiva com suprimento de ar. Quanto às instalações, é necessário seguir as recomendações do NB-3, sendo que o edifício deve ser em um prédio separado ou mesmo em uma área completamente isolada. Aqui, não basta o vedamento: o laboratório não deve conter janelas. Já os sistemas de abastecimento e escape devem ser a vácuo e apresentar eficiente sistema de descontaminação. A autoclave deve estar dentro do laboratório e ter dupla porta. Uma requisição exclusiva do nível 4 é a monitoração de segurança por meio de tecnologias, como: circuito interno de TV, visores, interfones e, até mesmo, acesso por meio de leitor biométrico. As práticas de segurança também devem ser executadas criteriosamente e envolvem: mudança de roupa antes de entrar; banho ao sair; descontaminação de todo o material na saída do laboratório; incineração dos resíduos. Tendo em vista a classificação por níveis de biossegurança apresentada, você acredita que seu laboratório esteja devidamente preparado para cumprir com as normas de biossegurança recomendadas? Caso não esteja, é recomendado contar com um profissional para avaliar as atividades e determinar, de acordo com as normas, as medidas necessárias. Isso retrata um compromisso não só com aspectos legais, mas com toda a população, visto que tanto os seres humanos como também os animais são afetados pelas riscos biológicos. Ficou alguma dúvida? Deixe um comentário aqui, e teremos prazer em esclarecer! Antes de continuar a leitura do texto, quero te convidar para conhecer meus cursos: Continue agora com a sua leitura do texto. Espero que goste. A biossegurança é o conjunto de medidas destinadas a prevenir riscos inerentes às atividades dos laboratórios de assistência, ensino, pesquisa e desenvolvimento tecnológico, que possam comprometer a saúde dos profissionais e o meio ambiente. O nível de Biossegurança de um procedimento será determinado segundo o agente biológico de maior classe de risco envolvido. Quando não se conhece a patogenicidade do agente biológico deve-se realizar uma avaliação do risco para estimar o nível de contenção. A Comissão Técnica Nacional de Biossegurança (CTNBio) é responsável pelas atribuições relativas ao estabelecimento de normas, análise de risco, definição dos Níveis de Biossegurança e classificação de Organismos Geneticamente Modificados (OGM). As características físicas, estruturais e de contenção de um laboratório determinam o tipo de micro-organismo que pode ser manipulado em suas dependências. Conheça agora os quatro níveis de biossegurança (NBs): Nível 1 de Biossegurança (NB-1) O NB-1 é adequado ao trabalho que envolva agente com menor grau de risco (Classe de Risco I) para profissionais do laboratório e para o meio ambiente. É necessária a aplicação das boas práticas laboratoriais e utilização de Equipamentos de Proteção Individual (EPIs). Os EPIs são dispositivos ou produtos, de uso individual utilizado pelo trabalhador, destinados à proteção de riscos suscetíveis de ameaçar a segurança e a saúde no trabalho. Como exemplos de EPIs temos: jaleco/avental, óculos de proteção, máscaras e sapatos fechados. O trabalho geralmente é conduzido em bancadas abertas, não exigindo equipamentos especiais de contenção. Os profissionais devem ter treinamento específico nos procedimentos realizados e trabalhar sob supervisão. O acesso ao laboratório é limitado ou restrito de acordo com definição do responsável e não será permitida a entrada de animais e crianças. O laboratório não fica separado das demais dependências do edifício e deve possuir uma pia específica para lavar as mãos. Nível 2 de Biossegurança (NB-2) O NB-2 é adequado ao trabalho que envolva agentes de risco moderado para os profissionais e para o meio ambiente, em geral agentes causadores de doenças infecciosas (Classe de Risco II). Além das especificações estabelecidas para o NB-1, as instalações devem ter: Autoclave para descontaminação, no interior ou próxima ao laboratório, de modo a permitir a descontaminação de todo o material antes do seu descarte; A autoclave é um equipamento utilizado na esterilização por calor úmido de materiais contaminados, tornando-os seguros para serem descartados ou reutilizados. Cabine de Segurança Biológica Classe I ou II e centrífuga com caçapa protegida sempre que houver manipulação de materiais em que possa existir a formação de aerossóis. A cabine de segurança biológica é o principal equipamento de contenção física para agentes infecciosos. Protegem o material e o profissional, na manipulação de materiais biológicos altamente infectantes, substâncias tóxicas e cultura de células. Devem estar em local de pouco trânsito e distantes de portas. Existem três tipos de cabine de segurança biológica (Classes I, II e III). Os profissionais devem receber treinamento específico no manejo de agentes patogênicos, ser orientados sobre os possíveis riscos e trabalhar sob supervisão. O acesso ao laboratório é limitado durante os procedimentos operacionais. Nível 3 de Biossegurança (NB-3) O NB-3 é adequado ao trabalho com micro-organismos de elevado risco infeccioso (Classe de Risco III) podendo causar doenças sistêmicas sérias e potencialmente letais como Mycobacterium tuberculosis, Coxiella burnetti e Brucella spp., entre outros. Devem ser utilizadas barreiras de proteção individual e toda manipulação realizada em cabine de segurança biológica classe II ou III, com filtro HEPA. O filtro HEPA (High Efficiency Particulate Arrestance) é um tipo de filtro de ar com alta eficiência na separação de partículas. É composto por uma malha de fibras de vidro dispostas aleatoriamente, com diâmetros entre 0,5 e 2 µm. É utilizado para evitar a propagação de micro-organismos através do ar. Deve-se oferecer treinamento específico aos funcionários no manejo de agentes patogênicos e potencialmente letais, assim como orientar sobre os possíveis riscos e trabalhar sob supervisão. Quando não houver condições específicas para o NB-3 as atividades de rotina e operações repetitivas podem ser realizadas em laboratório com instalação NB-2, acrescidas de equipamentos de contenção e das práticas recomendadas para NB-3. O acesso ao laboratório é controlado. Menores de idade não serão permitidos dentro do laboratório. Nível 4 de Biossegurança (NB-4) O NB-4 representa o nível máximo de segurança. É adequado ao manuseio de agentes infecciosos que possuem alto risco de infecção individual e de transmissão pelo ar sempre que o trabalho envolver OGM resultante de organismo receptor ou parenteral classificado como classe de risco NB-4. Brasil. Agência Nacional de Vigilância Sanitária. Microbiologia Clínica para o Controle de Infecção Relacionada à Assistência à Saúde. Módulo 1: Biossegurança e Manutenção de Equipamentos em Laboratório de Microbiologia Clínica. Brasília: Anvisa, 2013. The Motorsport Images Collections captures events from 1895 to today’s most recent coverage.Discover The CollectionCurated, compelling, and worth your time. Explore our latest gallery of Editors’ Picks.Browse Editors' FavoritesExperience AI-Powered CreativityThe Motorsport Images Collections captures events from 1895 to today’s most recent coverage.Discover The CollectionCurated, compelling, and worth your time. Explore our latest gallery of Editors’ Picks.Browse Editors' FavoritesExperience AI-Powered CreativityThe Motorsport Images Collections captures events from 1895 to today’s most recent coverage.Discover The CollectionCurated, compelling, and worth your time. Explore our latest gallery of Editors’ Picks.Browse Editors' FavoritesExperience AI-Powered Creativity Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Set of biocontainment precautions Essential features of a biosafety level 4 (BSL-4) laboratory[1] A biosafety level (BSL), or pathogen/protection level, is a set of biocontainment precautions required to isolate dangerous biological agents in an enclosed laboratory facility. The levels of containment range from the lowest biosafety level 1 (BSL-1) to the highest at level 4 (BSL-4).[2] In the United States, the Centers for Disease Control and Prevention (CDC) have specified these levels in a publication referred to as Biosafety in Microbiological and Biomedical Laboratories (BMBL).[3] In the European Union (EU), the same biosafety levels are defined in a directive.[4] In Canada the four levels are known as Containment Levels.[5] Facilities with these designations are also sometimes given as P1 through P4 (for pathogen or protection level), as in the term P3 laboratory.[6] At the lowest level of biosafety, precautions may consist of regular hand-washing and minimal protective equipment. At higher biosafety levels, precautions may include airflow systems, multiple containment rooms, sealed containers, positive pressure personnel suits, established protocols for all procedures, extensive personnel training, and high levels of security to control access to the facility. Health Canada reports that world-wide until 1999 there were recorded over 5,000 cases of accidental laboratory infections and 190 deaths.[7] The first prototype Class III (maximum containment) biosafety cabinet was fashioned in 1943 by Hubert Kaempf Jr., then a U.S. Army soldier, under the direction of Arnold G. Wedum, Director (1944–1969) of Industrial Health and Safety at the United States Army Biological Warfare Laboratories, Camp Detrick, Maryland. Kaempf was tired of his MP duties at Detrick and was able to transfer to the sheet metal department working with the contractor, the H.K. Ferguson Co.[8] On 18 April 1955, fourteen representatives met at Camp Detrick in Frederick, Maryland. The meeting was to share knowledge and experiences regarding biosafety, chemical, radiological, and industrial safety issues that were common to the operations at the three principal biological warfare (BW) laboratories of the U.S. Army.[9] Because of the potential implication of the work conducted at biological warfare laboratories, the conferences were restricted to top level security clearances. Beginning in 1957, these conferences were planned to include non-classified sessions as well as classified sessions to enable broader sharing of biological safety information. It was not until 1964, however, that conferences were held in a government installation not associated with a biological warfare program.[10] Over the next ten years, the biological safety conferences grew to include representatives from all federal agencies that sponsored or conducted research with pathogenic microorganisms. By 1966, it began to include representatives from universities, private laboratories, hospitals, and industrial complexes. Throughout the 1970s, participation in the conferences continued to expand and by 1983 discussions began regarding the creation of a formal organization.[10] The American Biological Safety Association (ABSA) was officially established in 1984 and a constitution and bylaws were drafted the same year. As of 2008, ABSA includes some 1,600 members in its professional association.[10] In 1977, Jim Peacock of the Australian Academy of Science asked Bill Snowdon, then chief of the CSIRO's Australian Animal Health Laboratory (AAHL) if he could have the newly released United States' National Institutes of Health and the British equivalent requirements for the development of infrastructure for bio-containment reviewed by AAHL personnel with a view to recommending the adoption of one of them by Australian authorities. The review was carried out by CSIRO AAHL Project Manager Bill Curnow and CSIRO Engineer Arthur Jenkins. They drafted outcomes for each of the levels of security. AAHL was notionally classified as "substantially beyond P4". These were adopted by the Australian Academy of Science and became the basis for Australian legislation. It opened in 1985 costing AU$185 million, built on Corio Oval.[11] The Australian Animal Health Laboratory is a Class 4/ P4 Laboratory.[12][13] In 2003, the Chinese Academy of Sciences approved the construction of mainland China's first BSL-4 laboratory at the Wuhan Institute of Virology (WIV). In 2014, the WIV's National Bio-safety Laboratory was built at a cost of 300 million yuan (US$44 million), in collaboration and with assistance from the French government's CIRI lab.[14][15][16] In 2007 a scientific review paper stated that the Canadian Science Centre for Human and Animal Health, which was designed in the early 1990s, "has become the prototype for modern BSL4 laboratories".[17] Starting with the 2020 COVID-19 pandemic near the facilities of the WIV, work in biocontainment facilities has been politicized, especially in the US Senate for example as the result of Rand Paul's work.[18] Russia asked questions on 25 October 2022 in the United Nations over the presence in Ukraine of biolabs.[19] In April 2023, Sudan's descent into civil war caused worries at the World Health Organization over its National Public Laboratory as contending factions battled over its area and NPL staff were kicked out in favor of installing a military base at its premises.[20] At the time, the facility contained organisms rated at BSL-2.[21] Biosafety level 1 (BSL-1) is suitable for work with well-characterized agents which do not cause disease in healthy humans. In general, these agents should pose minimal potential hazard to laboratory personnel and the environment.[22] At this level, precautions are limited relative to other levels. Laboratory personnel must wash their hands upon entering and exiting the lab. Research with these agents may be performed on standard open laboratory benches without the use of special containment equipment. However, eating and drinking are generally prohibited in laboratory areas.[22] Potentially infectious material must be decontaminated before disposal, either by adding a chemical such as bleach or isopropanol or by packaging for decontamination elsewhere.[22] Personal protective equipment is only required for circumstances where personnel might be exposed to hazardous material.[22] BSL-1 laboratories must have a door which can be closed to limit access to the lab. However, it is not necessary for BSL-1 labs to be isolated from the general building.[23] This level of biosafety is appropriate for work with several kinds of microorganisms including non-pathogenic strains of Escherichia coli and Staphylococcus, Bacillus subtilis, Saccharomyces cerevisiae and other organisms not suspected to contribute to human disease.[24] Due to the relative ease and safety of maintaining a BSL-1 laboratory, these are the types of laboratories generally used as teaching spaces for high schools and colleges.[23] At this level, all precautions used at Biosafety level 1 are followed, and some additional precautions are taken. BSL-2 differs from BSL-1 in that: "laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists."[25][26] Access to the laboratory is limited when work is being conducted. Certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.[22] Extreme precautions are taken with contaminated sharp items. Biosafety level 2 is suitable for work involving agents of moderate potential hazard to personnel and the environment.[23] This includes various microbes that cause mild disease to humans, or are difficult to contract via aerosol in a lab setting.[27] Examples of pathogens classified as "Risk Group 2" in the United States include seasonal influenza,[28] SARS-CoV-2,[29] hepatitis A, B, and C viruses, human immunodeficiency virus (HIV), pathogenic strains of Escherichia coli and Staphylococcus, Salmonella, Plasmodium falciparum, and Toxoplasma gondii.[27][30] Notably, the European Union departs from the United States and classifies HIV and hepatitis B – G as Risk Group 3 agents best handled at BSL-3.[31] Prions, the infectious agents that transmit prion diseases such as vCJD, are typically handled under Biosafety Level 2 or higher.[25] This is due to the lack of any evidence of aerosol transmission and relatively higher infective dose of prion diseases, though some circumstances (such as handling animal-infective prions in a facility which cares for vulnerable animals) would require BSL-3 conditions.[25] Dr Terrence Tumpey at US Centers for Disease Control, Atlanta, Georgia, US, working with influenza virus under biosafety level 3 conditions, with respirator inside a biosafety cabinet (BSC). Biosafety level 3 is appropriate for work involving microbes which can cause serious and potentially lethal disease via the inhalation route.[22] This type of work can be done in clinical, diagnostic, teaching, research, or production facilities.[23] Here, the precautions undertaken in BSL-1 and BSL-2 labs are followed, as well as additional measures including: A laboratory-specific biosafety manual must be drafted which details how the laboratory will operate in compliance with all safety requirements.[22] All laboratory personnel are provided medical surveillance and offered relevant immunizations (where available) to reduce the risk of an accidental or unnoticed infection.[22] All procedures involving infectious material must be done within a biosafety cabinet.[22] Lab personnel must wear solid-front protective clothing (i.e. gowns that tie in the back). This cannot be worn outside of the lab and must be discarded or decontaminated after each use.[22] Also, the facility which houses the BSL-3 lab must have certain features to ensure appropriate containment. The entrance to the lab must be separated from areas of the building with unrestricted traffic flow.[22] Also, the lab must be behind two sets of self-closing doors (to reduce the risk of aerosols escaping).[23] The construction of the lab is such that it can be easily cleaned. Carpets are not permitted, and any seams in the floors, walls, and ceilings are sealed to allow easy cleaning and decontamination.[22] Also, windows must be sealed, and a ventilation system installed which forces air to flow from the "clean" areas of the lab to the areas where infectious agents are handled.[22] Air from the lab must be filtered before it can be recirculated.[22] A 2015 study by USA Today journalists, identified more than 200 lab sites in the U.S. that were accredited biosafety levels 3 or 4.[32] The Proceedings of a Workshop on "Developing Norms for the Provision of Biological Laboratories in Low-Resource Contexts" provides a list of BSL-3 laboratories in those countries.[33] Biosafety level 3 is commonly used for research and diagnostic work involving various microbes which can be transmitted by aerosol and/or cause severe disease. These include Francisella tularensis, Mycobacterium tuberculosis, Chlamydia psittaci, Venezuelan equine encephalitis virus, Eastern equine encephalitis virus, SARS-CoV-1, MERS-CoV, Coxiella burnetii, Rift Valley fever virus, Rickettsia rickettsii, several species of Brucella, chikungunya, yellow fever virus, West Nile virus, and Yersinia pestis.[30] See also: List of biosafety level 4 organisms CDC technician dons an older-model positive-pressure suit before entering one of the CDC's earlier BSL-4 labs. Biosafety level 4 (BSL-4) is the highest level of biosafety precautions, and is appropriate for work with agents that could easily be aerosol-transmitted within the laboratory and cause severe to fatal disease in humans for which there are no available vaccines or treatments. BSL-4 labs are generally set up to be either cabinet laboratories or protective-suit laboratories.[2] In cabinet laboratories, all work must be done within a class III biosafety cabinet. Materials leaving the cabinet must be decontaminated by passing through an autoclave or a tank of disinfectant. The cabinets themselves are required to have seamless edges to allow easy cleaning. Also, the cabinet and all materials within must be free of sharp edges to reduce the risk of damage to the gloves. In a protective-suit lab, all work must be done in a class II biosafety cabinet by personnel wearing a positive pressure suit. To exit a BSL-4 lab, personnel must pass through a chemical shower for decontamination, then a room for removing the positive-pressure suit, followed by a personal shower. Entry into the BSL-4 lab is restricted to trained and authorized individuals, and all persons entering and exiting the lab must be recorded.[22] As with BSL-3 laboratories, BSL-4 labs must be separated from areas that receive unrestricted traffic. Also, airflow is tightly controlled to ensure that air always flows from "clean" areas of the lab to areas where work with infectious agents is being performed. The entrance to the BSL-4 lab must also employ airlocks to minimize the possibility that aerosols from the lab could be removed from the lab. All laboratory waste, including filtered air, water, and trash must also be decontaminated before it can leave the facility.[22] Biosafety level 4 laboratories are used for diagnostic work and research on easily transmitted pathogens which can cause fatal disease. These include a number of viruses known to cause viral hemorrhagic fever such as Marburg virus, Ebola virus, Lassa virus, and Crimean-Congo hemorrhagic fever. Other pathogens handled at BSL-4 include Hendra virus, Nipah virus, and some flaviviruses. Also, poorly characterized pathogens which appear closely related to dangerous pathogens are often handled at this level until enough data is obtained either to confirm continued work at this level, or to permit working with them at a lower level.[30] This level is also used for work with smallpox virus, though this work is only performed at the Centers for Disease Control and Prevention in Atlanta, United States, and the State Research Center of Virology and Biotechnology in Koltsovo, Russia.[34] Regular inspection of positive-pressure suits to locate any leaks[35] SPECT machine at BSL-4 imaging facility that separates subjects with pathogens from the machines[1] The circular containment tube separates the patient table in the "hot" zone (pathogen present) from the "cold" zone around this MRI machine. Air pressure resistant (APR) door to separate the hot and cold zones Working inside a BSL-4 lab with air hoses providing positive air pressure Inside a Class III biological safety cabinet with an aerosol control platform Effluent decontamination system of a BSL-4 lab of NIAID Main article: Extraterrestrial sample curation Sample-return missions that bring samples from a Category V body back to Earth must be curated at facilities rated BSL-4. Because the existing BSL-4 facilities in the world do not provide the level of cleanliness needed for such pristine samples,[36] there is a need to design a facility dedicated to curation of restricted (potentially biohazardous) extraterrestrial materials. The systems of such facilities must be able to contain unknown biohazards, as the size of any putative alien microorganism is unknown. Ideally, it should filter particles down to 10 nanometers, and release of a particle 50 nanometers or larger is unacceptable under any circumstance.[37] Because NASA and ESA are collaborating on the Mars Sample Return campaign, due to return samples from Mars in the early 2030s, the need for a Sample Receiving Facility (SRF) is becoming more pressing. An SRF is expected to take 7 to 10 years from design to completion,[38][39] and an additional two years is recommended for the staff to become proficient and accustomed to the facilities.[38] A North Carolina Mosquito & Vector Control Association (NCMVCA) study highlighted safety concerns. In the United States, laboratories can be funded by federal, state, private, non-profit, or academically. The last accounts for 72% of the funding.[40] High-containment labs that are registered with the Centers for Disease Control and Prevention (CDC) and the U.S. Department of Agriculture's (USDA) Select Agent Program must adhere to Department of Defense standards.[41] Since BSL3 and 4 laboratories in the United States are regulated by either the CDC or USDA or another federal agency (depending on the pathogens they handle), no single federal agency is responsible for regulating or tracking the number of these labs.[42] U.S. high-containment laboratories that handle pathogens which are declared as "select agents" must be inspected periodically by the CDC or USDA, adhere to certain standards, and maintain ongoing education on biosecurity and biosafety policies as mandated by law.[43] This list is incomplete; you can help by adding missing items. (March 2014) According to a U.S. Government Accountability Office (GAO) report published on 4 October 2007, a total of 1,356 CDC/USDA registered BSL-3 facilities were identified throughout the United States.[44] Approximately 36% of these laboratories are located in academia. 15 BSL-4 facilities were identified in the U.S. in 2007, including nine at federal labs.[44] As of May 2021, there are 42 BSL-4 facilities in operation around the world, with a further 17 planned or under construction.[45] The following is a list of existing BSL-4 facilities worldwide. Country Location Name Dateestablished Description Argentina Buenos Aires National Service of Healthcare and Agriculture Quality (SENASA) Diagnostic laboratory for foot-and-mouth disease.[46] Australia Geelong, Victoria Australian Centre for Disease Preparedness 1985 Capable of housing from large experimental animals to insects under conditions that exceed all BSL 4 requirements. The antecedent of all such facilities developed since the 1980s. Arguably the most researched design and construction project ever. The ACDP is subdivided into a number of isolation zones that can be managed at differing containment levels concurrently. CSIRO AAHL Project Manager and Architect, William Curnow, provided technical reviews to Canadian, Indian, UK and French Authorities and consulted with Dr Jerry Callis [PIADC] to UN FAO on matters of bio-containment. Formerly known as the Australian Animal Health Laboratory (AAHL) and renamed to Australian Centre for Disease Preparedness April 2020 Melbourne, Victoria University of Melbourne – Doherty Institute for Infection and Immunity 2014 Diagnostic reference lab.[47][13] National High Security Laboratory Operates under the auspice of the Victoria Infectious Diseases Reference Laboratory.[48] Belarus Minsk Republican Research and Practical Center for Epidemiology and Microbiology (RPPCM) Formerly the SRIEM.[49] Brazil Pedro Leopoldo, Minas Gerais Laboratório Nacional Agropecuário de Minas Gerais (Lanagro/MG) 2014 Focus on Agropecuary diseases and diagnostics, like the foot-and-mouth disease.[50] Campinas, São Paulo Laboratório Nacional de Máxima Contenção Biológica (LNMCB) 2026 (expected) It was announced in 2021 to be built near the Sincrotron lab.[51][52] Canada Winnipeg, Manitoba National Microbiology Laboratory 1999[53] Located at the Canadian Science Centre for Human and Animal Health, it is jointly operated by the Public Health Agency of Canada and the Canadian Food Inspection Agency.[54] Saskatoon, Saskatchewan Vaccine and Infectious Disease Organization 2025 (estimated)[55] Operated by the University of Saskatchewan and located near the Canadian Light Source.[56] China Wuhan, Hubei Wuhan Institute of Virology of the Chinese Academy of Sciences 2015 Wuhan Institute of Virology has existed since 1956 and already hosted BSL-3 laboratories. A BSL-4 facility was completed in 2015, and became the first BSL-4 laboratory in China.[57] Harbin, Heilongjiang Harbin Veterinary Research Institute of the Chinese Academy of Agricultural Sciences 2018 Harbin Veterinary Research Institute researches prevention and control of major infectious diseases. China's second, and the first for large animals, BSL-4 lab.[58] Czech Republic Těchonín, Pardubice Region Biological Defense Center 1971, rebuilt 2003–2007 Hospital and research facility. Located at the Centrum biologické ochrany (Biological Defense Center). Operated by Army of the Czech Republic.[59] France Brétigny-sur-Orge, Essonne French Armed Biomedical Research Institute, French Defence Health Service 2015 French Army laboratory.[60] Lyon, Metropolis of Lyon Jean Mérieux BSL-4 Laboratory 1999 Built and owned by the Fondation Mérieux. Since 2004, operated by INSERM.[61] Vert-le-Petit, Essonne French general directorate of armaments (DGA) 2013 Operated by the Ministry of Defense.[62] Gabon Franceville, Haut-Ogooué Province Centre International de Recherches Médicales de Franceville This facility is operated by a research organization supported by both Gabonese (mainly) and French governments, and is West Africa's only P4 lab (BSL-4).[63] Germany Berlin Robert Koch Institute 2015 Diagnostic and experimental lab facility.[64] Hamburg Bernhard Nocht Institute for Tropical Medicine 2014 Part of the Leibniz Center Infection. National reference lab for tropical viruses.[65] Greifswald, Mecklenburg-Vorpommern Friedrich Loeffler Institute 2010 Focus on animal viral diseases and diagnostics.[66] Marburg, Hesse Philipps University of Marburg 2008 Focuses on hemorrhagic fever viruses.[67] Hungary Budapest National Center for Epidemiology 1998 Division of Virology operates three WHO National Reference Laboratories. The BSL-4 biosafety laboratory provides a modern means to process dangerous imported zoonotic viral pathogens.[68] Pécs, Baranya County University of Pécs 2016 Opened in 2016, part of Szentágothai János Kutatóközpont.[69] India Bhopal, Madhya Pradesh National Institute of High Security Animal Disease 1998 This BSL-3+ facility deals especially to zoonotic organisms and emerging infectious disease threats.[70] Pune, Maharashtra National Institute of Virology 2012 India's most advanced BSL-4 category lab.[71] Italy Rome, Lazio Istituto Nazionale per le Malattie Infettive 1997 The "National Institute of Infectious Diseases" used to operate within the Lazzaro Spallanzani hospital; the facility is now independent and is home to five BSL-3 labs as well as a single BSL-4 laboratory, which was completed in 1997.[72] Milan, Lombardy Ospedale Luigi Sacco 2006 Japan Musashimurayama, Tokyo National Institute for Infectious Diseases 2015 Located at National Institute for Infectious Diseases, Department of Virology I. Built in 1981; operated at BSL-3 until 2015 due to opposition from nearby residents.[73] Nagasaki, Nagasaki Prefecture Nagasaki University 2021 Facility for the study of infectious diseases.[74] Tsukuba, Ibaraki Prefecture Institute of Physical and Chemical Research (RIKEN) 1984 Facility completed in 1984 but not operated as BSL-4 due to local opposition.[75] Philippines New Clark City, Capas, Tarlac Virology Institute of the Philippines 2024 (expected) First BSL-4 Lab in the Philippines when completed.[76] Russia Sergiyev Posad, Moscow Oblast 48th Central Scientific Research Institute Sergiev Posad[49] Koltsovo, Novosibirsk Oblast State Research Center of Virology and Biotechnology (VECTOR) One of two WHO-approved facilities for work on smallpox virus.[34] Singapore Central Region DSO National Laboratories End-2025 (expected) First BSL-4 Lab in Singapore when completed.[77] South Africa Johannesburg, Gauteng National Institute for Communicable Diseases 2002 [78] South Korea Cheongju, North Chungcheong Province Korea Centers for Disease Control and Prevention 2017 First BSL-4 Lab in South Korea.[79][80] Sweden Solna, Stockholm County Public Health Agency of Sweden 2001 The only BSL-4 facility in the Nordic region. Constructed for research and diagnostics of hemorrhagic fever viruses.[81] Switzerland Geneva, Canton of Geneva University Hospital of Geneva "Glove box" type laboratory; primarily for handling clinical samples.[82] Spiez, Canton of Bern Spiez Laboratory 2013 Run by the Federal Office for Civil Protection of the Federal Department of Defence, Civil Protection and Sports.[83] Mittelhäusern, Canton of Bern The Institute of Virology and Immunology IVI[84] Part of the Food Safety and Veterinary Office (FSVO).[85] Primary purpose is diagnostics of highly pathogenic viruses.[83] Taiwan Taipei National Defense University – Institute of Preventive Medicine 1983 [86] Kwen-yang Laboratory [zh] [87][circular reference] United Kingdom Camden, Greater London Francis Crick Institute 2015 Has BSL-4 space but does not work on human pathogens.[88] Colindale, Greater London Public Health England's Centre for Infections Department of Health laboratory. Diagnostics for various viral diseases.[89] Part of the European Network of Biosafety-Level-4 Laboratories.[90] Mill Hill, Greater London National Institute for Medical Research Medical Research Council laboratory. Research and diagnostics for highly pathogenic viruses. Closed in 2017 and work moved to the Francis Crick Institute. Site demolished in 2018.[89] Potters Bar, Hertfordshire National Institute for Biological Standards and Control Department of Health and Home Office laboratory. Develop assays and reagents for research on virulent pathogens.[89] Addlestone, Surrey Animal and Plant Health Agency Department for Environment, Food and Rural Affairs laboratory. Diagnostics and research for animal diseases.[89] Pirbright, Surrey Institute for Animal Health Biotechnology and Biological Sciences Research Council laboratory. Research on highly pathogenic animal diseases.[89] Merial Animal Health Private lab. Produces vaccines against foot and mouth disease and bluetongue disease.[89] Porton Down, Wiltshire UK Health Security Agency Department of Health laboratory. Diagnostics and research for haemorrhagic fever viruses.[89] Part of the European Network of Biosafety-Level-4 Laboratories.[90] Defence Science and Technology Laboratory Ministry of Defence laboratory. Focuses on protection from biological weapons.[89] United States Atlanta, Georgia Centers for Disease Control and Prevention Currently operates in two buildings. One of two facilities in the world that officially hold smallpox.[34] Georgia State University 1997 Research focus on B virus.[91] Manhattan, Kansas National Bio and Agro-Defense Facility (NBAF) 2023 Facility is operated by the Department of Homeland Security, and will replace the Plum Island Animal Disease Center. Began operation in 2023.[92][93] Bethesda, Maryland National Institutes of Health (NIH) Located on the NIH Campus, it currently only operates with BSL-3 agents.[94] Fort Detrick, Maryland Integrated Research Facility Operated by National Institute of Allergy and Infectious Diseases (NIAID). Focuses on animal models of human diseases.[95] National Biodefense Analysis and Countermeasures Center Operated by the Department of Homeland Security. Focus on potential bioterrorism threats.[96] US Army Medical Research Institute of Infectious Diseases (USAMRIID) 1969 Run by the United States Army. Research focuses on biological threats to the U.S. military.[97][98] Boston, Massachusetts National Emerging Infectious Diseases Laboratory (NEIDL), Boston University Built 2008, Opened 2012,[99] BSL-4 Approval in 2017[100] Focus on potential threats to public health.[101] Operated by Boston University School of Medicine.[102] Hamilton, Montana Rocky Mountain Laboratories Integrated Research Facility 2008 NIAID laboratory. Focus on vector-borne diseases.[103] Galveston, Texas Galveston National Laboratory, National Biocontainment Facility Opened in 2008, facility is operated by the University of Texas Medical Branch (UTMB).[104] Shope Laboratory 2004 Operated by UTMB.[105] San Antonio, Texas Texas Biomedical Research Institute 1999 The only privately owned BSL-4 lab in the US.[106] Richmond, Virginia Virginia Division of Consolidated Laboratories 2003 A BSL-4 lab that also acts as a BSL-3 lab.[107] Aeromedical Isolation Team Biocontainment Biological hazard Biosafety Hazmat suit Interplanetary contamination Laboratory Response Network List of laboratory biosecurity incidents Safety engineering Security engineering Select agent ^ a b "Integrated Research Facility". niaid.nih.gov. NIAID. Archived from the original on 28 November 2014. Retrieved 14 November 2014.