

# Innovative Scientific, Business and Social Practices for Sustainable Development

**Chief Editor:**  
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## AN OVERVIEW OF INFECTION CAUSED by Burkholderia spp.

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### Abstract :

Burkholderia is an important bacterial species. The genus Burkholderia contain metabolically diverse and adaptable gram negative bacteria these includes B. mallei and B. pseudomallei of the B.pseudomallei complex which causes glanders and melioidosis, relatively B.cenocepacia B.multivorans and B.vietnamiensis be a member of Burkholderia cepacia complex and effect mostly cystic fibrosis patients. Burkholderiacepaciaan aerobic Gram negative bacillus. It poses little risk of infection to healthy people. In this review, we aimed to establish the commonness of Burkholderia species among cystic fibrosis patients over the recent years.

### History -

B.cepacia was discovered by Walter

Burkholder in 1949 as the disease causing agent of onion skin rot. This bacteria was first described as a human pathogen in the 1950s [12]. It was first isolated in patients with cystic fibrosis (CF) in 1977, when it was known as *Pseudomonas cepacia* [13]. In the 1980s, outbreaks of *B. cepacia* in individuals with CF were associated with a 35% death rate. *B. cepacia* has a large genome, containing twice the amount of genetic material as *E. coli* [6].

#### INTRODUCTION:-

*Burkholderia* is a genus of proteobacteria. The *Burkholderia* is Gram negative, catalyst producing, lactose non-forming, obligately aerobic bacilli and include the species of *Burkholderia cepacia* complex bulk cold area mainly *Burkholderia pseudomallei* and *B. gladioli* [4]. *Burkholderia cepacia* complex consists of at least 20 different species including *B. cepacia* and *Burkholderia multivorans* and *Burkholderia cenocepacia* [1, 3]. *B. cepacia* complex was first described in mid-1980, in cystic fibrosis patients as a cause of 'cepacia syndrome'. Characterized by lung function deterioration bacteremia and death [6]. The cystic fibrosis is caused by mutations in the gene that produces the cystic fibrosis transmembrane conductance regulator protein, this protein responsible for regulating the flow of salt and fluids in and out of the cell in different parts of the body [2].

The members of *B. cepacia* complex are widely distributed in the environment including water soil fruits and vegetables and survive for long period of time in moist environment [6, 7]. *B. cepacia* complex rarely causes diseases in healthy individuals and is mostly an attack on cystic fibrosis patients.

The *B. cepacia* complex is composed of at least 20 different glucose non-forming Gram negative species typically isolated from soil water and humid environments and indistinguishable by phenotyping methods used in routine clinical microbiology laboratory

although these pathogens are commonly involved in respiratory tract infections of immunocompromised patients particularly with cystic fibrosis [2, 3].

*Burkholderia mallei* is a gram-negative bacterium that causes glanders a disease that occurs mostly in horses and donkeys and mules and other animals example camels, wolves, and dogs including humans. *Burkholderia mallei* is the acute form of glanders is observed in donkeys and mules with high fever and death occurs within few days [8, 18].

*Burkholderia pseudomallei* is a causative agent of Melioidosis. It is a life-threatening infection in both humans and animals. Water is a main reservoir of bacteria and serve as source of environmental contamination leading to infection. *B. pseudomallei* has ability to survive in water for long period of time [8]. *B. pseudomallei* is environmental saprophyte found in soil and water and infection is acquired through inoculation for inhalation from soil or water containing organisms. *Burkholderia pseudomallei* is a severe infectious disease. *B. cepacia* is a frequent colonizer of fluids used in hospital ward example irrigation solutions intravenous fluids antiseptic solutions. *B. cepacia* causes little risk of infection to healthy people [9]. *B. cepacia* complex comprises a group of closely related species of which *B. cenocepacia*, *B. multivorans* and *B. contaminans* are frequently isolated from cystic fibrosis patient. *B. cepacia* has emerged as another important bacterium cause of hospital acquired infections [9, 18]. The bacterium is known formally as a gram-negative, aerobic, glucose non-forming, motile bacillus. Disease such as cystic fibrosis and chronic granulomatous disease can be caused by *B. cepacia* in humans.

*Burkholderia pseudomallei* is the agent for melioidosis. Water is an important reservoir of the bacteria and may serve as a source of environmental contamination leading to

infection of *B. pseudomallei*. Melioidosis also called Whitmore's disease, it is an infectious disease that can infect humans or animals [5, 8]. It is predominantly a disease of tropical climates special in South Asia and northern Australia where it is widespread. It is spread to humans and animals through direct contact with the contaminated source [5].

*Burkholderia multivorans* is a member of *Burkholderia cepacia* complex whose members are inherently resistant to antibiotics and can cause chronic lung infection in patients with cystic fibrosis [11, 16] and are inherently resistant to many antibiotics. Mechanism of antibiotic-resistance reported in bulk hilarous facies include decreased intracellular accumulation enzymatic modification of drugs and alteration of target.

*Burkholderia contaminans* and *Burkholderia latra* together form group of the *B. cepacia* complex these predominantly environmental species and a major cause of pharmaceutical contamination although both species are capable of causing serious infections in humans [17].

*B. cepacia* poses little risk of infection to healthy people; however it is a known important opportunistic pathogen causing morbidity and mortality due to its intrinsic resistance to most of the antibiotics in hospitalized patients [3, 4]. Small hospital outbreaks are frequent and are usually due to single contaminated source such as disinfectant, intravenous solutions, nebulizer solutions, mouthwash, and medical devices, including respiratory therapy equipment [7, 14].

*Burkholderia* infections are particularly difficult to treat, as most pathogenic species are intrinsically resistant to major classes of antibiotics. There are currently no commercially available vaccines to protect mammals against *Burkholderia* infections [10]. In this literature review, we discussed infections caused by some pathogenic *Burkholderia* species: *Burkholderia*

*pseudomallei* (*Bpm*) and *B. cepacia* complex (*Bcc*). To conclude, we also discussed theories and putative therapeutics developed for other persistent bacterial pathogens to incite ideas for future research directions to address *Burkholderia* persistence and though *Bpm* and *Bcc* are the more prevalent and more studied *Burkholderia* species, it is important to note that there are other pathogenic *Burkholderia* including *B. mallei* that are able to cause persistence infections, yet the research of this subject is limited. The literature is summarize last 5 years of researches about the infection caused by these species [18, 1].

#### REVIEW OF LITERATURE:-

##### Overview of Melioidosis and Bcc Infections—

*Burkholderia pseudomallei* is a highly virulent pathogen and causative agent of melioidosis in humans and other mammals. This bacterium is a motile, saprophyte soil-dwelling microorganism. *Bpm* species are found in tropical and subtropical regions of the world and while Thailand and northern Australia and Southwest Asia are the predominant endemic regions for melioidosis infections, recently other parts of the world have been also declared endemic areas [5].

Melioidosis is an emerging disease among livestock in Malaysia, a country considered endemic for the disease. Water is one of the important environmental reservoirs of *B. pseudomallei* and may serve as a source of contamination and infection for humans and animals since the agent possesses the ability to survive even in distilled water for up to 16 years. In Taiwan, *B. pseudomallei* contaminated water was implicated as a source of the disease among human. Similarly, contaminated water supplies have also been implicated in outbreaks of melioidosis in humans in other endemic areas. Survival of *B. pseudomallei* in liquid suspension has been shown to be influenced by factors such as temperature, type of suspension medium, concentration of salt in the

medium and pH of the medium [8], physical and chemical properties of water samples taken from small ruminant farms that included temperature, pH dissolved oxygen, optical density and chemical oxygen demand were measured after which the sample were cultured for *Burkholderia pseudomallei* multivariable logistic regression model revealed that slightly acidic water pH and higher COD level were significantly associated with likelihood of *B. pseudomallei* present in the water [8,5].

Melioidosis a first described in Myanmar by Whitmore and Krishnaswamy in 1911. But now readily diagnostic there which is widespread in Southeast Asia [9]. The infection is acquired by people and animals through contact with soil and water. People with occupations such as farming or gardening in contaminated environments have a high risk of acquiring *Burkholderia pseudomallei* especially if they have underlying conditions that predispose them to infection such as diabetes mellitus. Further study of environmental *Burkholderia pseudomallei* in Myanmar is indicated to construct risk maps and identify places in which enhanced surveillance for Melioidosis should be undertaken [8, 26].

**Outbreak of Burkholderiacepacia complex**

The Burkholderiacepacia complex (Bcc) is composed of at least 20 different glucose non-fermenting Gram negative species, typically isolated from soil, water and humid environments, and indistinguishable by phenotypic methods used in routine clinical microbiology laboratories. Although these pathogens are commonly involved in respiratory tract infections of immunocompromised patients, particularly with cystic fibrosis. They are uncommon in ventilator-associated pneumonia (VAP) of intensive-care unit (ICU) inpatients. Bcc species are the bacteria most often isolated in microbiological cultures from nonsterile medical products [14].

*Burkholderiacepacia* causes little risk of

infection to healthy people however it is known important opportunistic pathogen causing morbidity and mortality due to its intrinsic resistant to most of the antibiotics in hospitalized patients [10, 14]. Small hospital outbreaks are frequent and are usually due to single contaminated source such as disinfectant, intravenous solutions, nebulizer solutions, mouthwash and medical devices including respiratory therapy equipment. So the process of manufacturing these products, even though they are categorized as nonsterile, must follow strict quality assessment criteria involving the use of the product, for example, how it can be applied and the intended recipient [14, 7].

**Table 1: Overview of the Burkholderiacepacia Complex\***

Species	Natural Environment	Clinical Environment
<i>B. cepacia</i>	Rhizosphere, soil, water	Cystic fibrosis (CF), medical solution
<i>B. multivorans</i>	Rhizosphere, soil, water	CF, CGD, non-CF
<i>B. cenocepacia</i>	Rhizosphere, plant, soil, water, animal	CF, non-CF
<i>B. stabilis</i>	Rhizosphere	CF, (rare) hospital equipment
<i>B. vietnamiensis</i>	Rhizosphere, plant, soil, water, animal	CF
<i>B. dolosa</i>	Maize rhizosphere, plant	CF
<i>B. ambiflora</i>	Rhizosphere, soil	CF (rare)
<i>B. anthina</i>	Rhizosphere, soil	CF (rare)
<i>B. pyroclina</i>	Rhizosphere, soil, water, plant	CF, non-CF (rare)
<i>B. tibonensis</i>	Soil	Nosocomial infection
<i>B. letens</i>	No environmental strain reported	CF
<i>B. diffusa</i>	Soil, water	CF, hospital equipment, non-CF
<i>B. abroxis</i>	Rhizosphere, soil, water	CF, non-CF
<i>B. seminalis</i>	Rice rhizosphere	CF, nosocomial infection
<i>B. metallica</i>	No environmental strain reported	CF
<i>B. contaminans</i>	Soil, water, animal	CF, hospital equipment, non-CF
<i>B. lata</i>	Soil, water, flower	CF, non-CF

\*Based on Ref. 11.  
\*Luigi Chiariniet al. 2006

**Infection caused by Burkholderiacepacia complex in cystic fibrosis patient –**

There are almost 20 different *B. cepacia* complex species. The species found most often in people with cystic fibrosis are:

1. *B. cenocepacia*
2. *B. multivorans*
3. *B. vietnamiensis*
4. *B. dolosa*
5. *B. cepacia*

Although not a member of *B. cepacia*

complex, *B. gladioli* is another *Burkholderia* species that can be found in the lungs of people with cystic fibrosis [20]. In many people with CF, infection with *B. cepacia* may not worsen lung disease. In up to one-third of people infected with *B. cepacia*, the rate of lung function decline appears to be only slightly faster. However, for a smaller number of people, *B. cepacia* can cause a rapid decline in lung function and health. This can lead to more severe lung disease and maybe death [20].

Cystic fibrosis is an inherited disease and people who have this disease produce large amounts of thick mucus which is difficult to clear. This mucus blocks up their lungs and digestive systems. People with cystic fibrosis suffer from lots of chest infections, which cause scarring of their airways. Eventually, they develop infections that can't be cured with antibiotics, so their lungs always contain lots of bugs, this is described as being chronically infected. One of these bugs, *B. cepacia*, causes a lot of problems for people with cystic fibrosis because it is very difficult to treat and makes their lung disease deteriorate faster than it otherwise would [27].

#### **Infection caused by *B. mallei*-**

*B. mallei* is a gram negative bacteria that causes glanders disease (a zoonotic disease) which mostly affected animals e.g. horses, donkeys, mules and rarely humans are known to be susceptible to *B. mallei* infection. Gland diseases spread to humans by direct contact with infected animals. The bacteria enters the body through the cuts or scraps in the skin and through mucosal surfaces of the eyes and nose [17]. Symptoms of *B. mallei* of fever with chills and sweating, Muscle ache, chest pain, muscle tightness, headache, nasal discharge.

Glanders is an infectious disease of equines that can be transmitted to humans. *Burkholderia mallei*, the etiological agent of glanders, is a gram-negative bacterium that

cannot persist in the environment outside its equine host. The disease typically manifests as acute or chronic, with the chronic form usually occurring in horses and the acute form occurring in mules and donkeys. Horses are the primary carriers of disease and are largely responsible for transmitting the infection to healthy animals and humans. The incubation period ranges from days to weeks, and animals can die within a week of the onset of clinical symptoms. There are three cardinal signs of clinical glanders in equines that can occur individually or in combination. The first cardinal sign is the presence of a chronic nasal discharge that occurs with or without ulceration of the nasal septum. *B. mallei* exhibits a tropism for upper respiratory tract passages, and the viscid nasal discharges are infectious and are commonly the source of contamination of communal food and water troughs.

Swollen lymph vessels are often present on the flanks of infected animals in a manifestation referred to as cording. The third cardinal sign of clinical glanders is the presence of nodules, pustules, or ulcers on the flanks and extremities of infected animals. As these nodules ulcerate, the resulting discharges can be the source of infection of healthy animals and humans. Horse-to-horse transmission is facilitated by crowding and through sharing food and water troughs with glanderous animals. There is no vaccine is no vaccine available for glanders. So early detection of the disease and quarantine of animals will protect against the spread of disease [21].

#### ***Burkholderia gladioli*:**

*Burkholderia gladioli* has been identified as a plant pathogen in gladiolus, Iris, onions and rice. It was originally described to have caused rot of gladiolus corms; the bulb can become water soaked and decay. Some other common symptoms of infected plant can be seen in leaves the leaves contain brown lesions and they became water soaked [20].



In humans, the *B. gladioli* is known to be a causative pathogen of pneumonia in cystic fibrosis and chronic granulomatous disease. *B. gladioli* in human is an opportunistic pathogen that important agent for hospitalized infections. It has recently appeared as severe pathogen in patients with cystic fibrosis causing severe pulmonary infections [17]. In lung transplant patients, infection can be fatal as patients have developed bacteremia and sterile wound infections as a result.

#### Treatment of *B. cepacia* and *B. gladioli*:

*Burkholderia cepacia* was successfully eradicated in a 14 year old boy with CF and *Burkholderia gladioli* was successfully eradicated in a six year old girl with CF. In both children two weeks of intravenous (IV) tobramycin, ceftazidime and temocillin were used followed by three months of inhaled tobramycin [28].

#### *Burkholderia glumae*:

*Burkholderia glumae* is a Gram-negative soil bacterium. *B. glumae* is seed-borne rice pathogen. Rice world production is affected due to the growing impact of diseases such as bacterial panicle blight, produced by *B. glumae*. The pathogen-induced symptoms include seedling rot, grain rot and leaf-sheath browning in rice plants [23]. It is currently recognized the entrance of this pathogen to the plant, from infected seeds and from environmental sources of the microorganisms [24].

Bacterial panicle blight caused by *B. glumae* is one of the most severe seed-borne bacterial diseases of rice in the world. Currently, this disease has affected many countries of Asia, Africa, South and North America. It is a typical example of the shifting from minor plant disease to major disease due to the changes of environmental conditions [25].

This may easily spread among crops. Bacteria flow through the water from infected plants to the roots and leaves of other plants. Water and wind helps to transfer the bacteria to other plants. Oxolinic acid can be used in seed treatment or foliar application, and is the only chemical that can control BPB by now.

However, it is not commercially available in some countries [10].

#### CONCLUSION:

There are many species of *Burkholderia* but in this review we discuss about infection caused by some common pathogenic *B. species*. i.e. *B. cepacia* complex and *B. pseudomallei* mostly caused in cystic fibrosis patients. *Burkholderia* spp. causes infection of the blood, soft tissue and respiratory tract. Since clinical diagnosis of infection caused by this bacteria is not possible, most cases worldwide probably go unrecognized because they occur in people who have limited access to diagnostic facilities. Several studies including ours, showed that these organisms are still sensitive to many of recommended antibiotics.

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**S. P. M. Science & Gilani Arts Commerce College, Ghatarji**




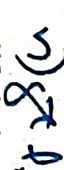
Dist - Yavatmal, Maharashtra, India  
(Affiliated to Sant Gadge Baba Amravati University)

## INTERNATIONAL MULTIDISCIPLINARY E-CONFERENCE (ISBSPSD-22)

# Certificate

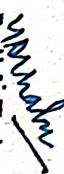
This is to certify that **Ram Kulkarni**, Anjangaon surji  
has participated and presented / published paper entitled **An overview of  
Infection caused by Burkholderia spp.**  
in international multidisciplinary E-Conference (ISBSPD-22) held on 20<sup>th</sup> september 2022 on  
Innovative Scientific, Business and Social Practices for Sustainable Development.

  
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