**Methodology**

**Search strategy:**

The following search terms were used in the process of identifying primary studies in the isolation of *M. avium* species over the course of 41 years (1980-2021) in the PubMed database. The key terms being:

* “Isolation of M. avium from different locations”
* “Isolation of M. avium from environmental sources”
* “Detection of M. avium from environmental sources”
* “Identification of M. avium from environmental sources”

Abstract based screening was conducted for the results obtained using these search terms to identify primary studies with relevant research in isolation, detection and identification of *M. avium* from potential sources. Both diagnosis-based results and data from environmental sources were consolidated. A total of 201 hits were obtained from the above-mentioned search terms. Further, full articles were procured for articles deemed relevant from abstract based screening, and pertinent information such as year of identification, geographical location of isolate and strains identified were compiled in supplementary table 1. The above information was mainly extracted from primary studies, google search engine etc. From a total of 201 citations captured by literature search, 81 articles were considered relevant for constructing a global map distribution of *M. avium*.

A global map was constructed from the above extracted data using (created on [https://mapchart.net/](https://mapchart.net/%22%20%5Ct%20%22_blank)). The map mainly represents the countries in which *M. avium* species have been detected. Further information on the detailed year, location, *M. avium* species and source of isolation has been laid out in supplementary table 1. Few regions have been mentioned in a recent report [1]

**Supplementary Table 1**: Detailed information on the source of isolation, year and strain of *M. avium* identified in different countries.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Year** | **Geographical location** | **Strain** | **Source** | **Ref** |
| 1. | **2020** | Zagreb, Coatia | MAC- *M. avium M. intracellulare* | Lungs of patients with NTM pulmonary infections | [2] |
| 2. | **2020** | St. Marianna University Hospital, Japan | *M. avium* including other NTM | Intestinal fluid culture from patients, endoscopic unit environment and samples of water used in the endoscopy unit | [3] |
| 3. | **2019** | Over 36 states in the US | *M. avium* | Office and residential tap water samples from kitchen sinks, bathroom sinks, utility sinks, drinking water fountains and refrigerator-door dispensers | [4] |
| 4. | **2019** | Southern Montgomery County or adjacent regions of Delaware County suburban Philadelphia, Pennsylvania, USA (Schuylkill River and its tributaries) | *M. avium* subsp.*hominissuis**M. intracellulare* | Plumbing sources from patient and control households, serviced by the same municipality water | [5] |
| 5. | **2018** | London, UK | *M. avium* type strain. | Employees of the factory who had potential exposure to aerosolised MWF (Metal working fluid) mist, samples of MWF were collected from 33 machine sumps and stored at 4°C | [6] |
| 6. | **2017** | Markets in Spain | *Mycobacterium**avium* subsp. *hominissu is**M*. *avium* subsp. *avium**M. avium* (subsp.*paratuberculosis*) | Dairy products including milk, milk powder, powdered infant formula, cream, butter, cheese and yogurt. Meat samples: packed ground meat, hamburger patties, fresh and cooked sausages, cold cuts, fresh Spanish chorizo and pâté | [7] |
| 7. | **2017** | South Australia, New South Wales, Victoria or WesternAustralia | MAC | Samples of Australian commercially available pasteurized milk. | [8] |
| 8. | **2016** | United States | *M. avium* and *M. intracellulare* | Source and treated drinking water collected from 25 drinking water treatment plants (DWTPs) in the United States | [9] |
| 9. | **2016** | Six communities along two major river basins (Densu and Offin) in GhanaThe communities along the Densu River basin included: Ntabea in the East Akim district, upstream of the river; Ashongkrom in the Akwapim South district, midstream of the river; and Domesampaman in the Ga-West Municipality of the Greater Accra Region, downstream of the river. All of the studied communities along the Offin River basin included Ntobroso and Achiase in the Atwima district, upstream and midstream of the river, respectively, and Mfantsiman in the Upper Denkyira district, downstream of the river | *M. avium* | Sites of frequent human activities, such as bodies of water utilized regularly for domestic purposes such as washing and cooking, communal bathing areas utilized by household members, school compounds (particularly playgrounds), agricultural farms, market grounds, community centers, and sources of drinking water, such as boreholes and water from storage tanks in homes, were used as reference points Samples such as soil (approximately 5 g), water (45 ml), and fungi found growing in the soil and on dead and decaying logs were collectedSnail samples, moss and vegetation | [10] |
| 10. | **2016** | Belgium | *M. avium* subspecies*hominissuis* | Human isolates isolated from submandibular lymph nodes of Belgian pigs with lymphadenitis | [11] |
| 11. | **2016** | Center of Tuberculosis and Lung Diseases, Latvia | *M. avium* subsp.*hominissuis**M. avium* subsp. *avium* | * Clinical *M. avium* samples, isolated from patients
* Isolates from pig necrotic mesenterial lymph nodes
 | [12] |
| 12. | **2015** | Papua New Guinea | *M. intracellulare**M. avium* | Sputum samples of suspected tuberculosis cases aged 15 years or older | [13] |
| 13. | **2015** | Beijing and Fujian province | *M. avium* subsp.*hominissuis* | Sputum samples of pneumonia patients | [14] |
| 14. | **2014** | Brno Czech republic | *M. avium* subsp.*paratuberculosis* | -Samples of moss, fungi, and algae from the pond and herb from sites on the pasture-tissues from the gastrointestinal tract were buried at 60 cm of depth in two locations, after 2 years samples of soil, leaves (aerial parts of plants), and roots were collected | [15] |
| 15. | **2014** | Province of Quebec, Canada | *M. avium* subsp. *paratuberculosis* strains | Samples from dairy herds | [16] |
| 16. | **2014** | Southern Alberta, Canada | *M. avium* | Hospital water distribution system | [17] |
| 17. | **2014** | -Mubende district in the central area of the UCC (Uganda cattle corridor)* Karamoja in the North eastern part of the UCC

pastoral communities (Karamoja, Nakasongola, Masindi and Mbarara), Uganda | *M. avium* subsp.*hominissuis**M. avium* subsp. *avium* | -Cervical lymph nodes of slaughter pigs-isolates from cervical lymph node biopsies of patients- lesion samples in slaughtered cattle | [18] |
| 18. | **2014** | Osaka, Japan | *M. avium* | Biofilm samples were collected from 5 sites in each of 40 residences, The 5 sites were bathroom drain, kitchen drain, bathtub inlet and outer and inner surfaces of showerhead. | [19] |
| 19. | **2014** | Veterinary Research Institute, Brno, Czech Republic. | *M. avium* subsp.*hominissuis**M. avium* subsp. *avium*and *paratuberculosis* | Field isolate obtained from infected swine | [20] |
| 20. | **2013** | Water distribution system in Mexico City; the water which includes groundwater (pumped from wells) and surface water from the Cutzamala and Magdalena rivers | *M. avium* | Potable water samples collected from both the “main house faucet” and kitchen faucet of the test households. | [21] |
| 21. | **2013** | -Seattle, USA-Montreal, Canada-New England region, USA-Netherlands-Sao Paolo, Brazil-Southern California region, USAItaly | *M. avium* | Archived genomic DNA isolates of *M. avium* | [22] |
| 22. | **2013** | Patients part of the long term studies at University of Texas Health Science Center at Tyler (UTHSCT)United States | *M. intracellulare* in respiratory isolates Household water: *M. chimaera*Other MAC isolates | * Patients with mycobacterial sinusitis (sputum) and from their household water were included for study

water samples and/or swab cultures of bathroom and kitchen faucet filters and pipes and showerhead filters and showerhead pipes, as well as samples from any other potential sites (e.g., air filters, hot tub filters, and bathtub inlet pipes, etc., when available | [23] |
| 23. | **2013** | Multiple areas of a U.S. medical center | *M. avium* with other amoeba isolates | Water samples, biofilm samples, patient rooms- interior surface of the showerhead, sink and faucet,drain* -Hospital pool: tile floor surrounding the pool, two water filters, the pool water, and a water dispenser used to feed water into the pool
 | [24] |
| 24. | **2012** | Two abattoirs in Korea (in Gyeonggi and Chungbuk) South Korea | *M. avium* subsp.*hominissuis* | Tissue samples of 234 animals with suspected TB lesions were collected isolated from a Korean native cattle from bronchial lymph nodes and lung, Hanwoo* (Bos taurus coreanae)
 | [25] |
| 25. | **2012** | Japan | *M. avium* subsp.*hominissuis* | Samples of sputum and the bronchoalveolar lavage fluid* Patient’s bathroom-bathtub, shower tap
 | [26] |
| 26. | 2009-2011**2012** | Isfahan, Iran | MAC along with other mycobacterium isolates (NTM) | Water samples were gathered from swimming pools, dentistry units,hemodialysis water ,offices water coolers* ,drinking tap water ,undrinkable tap water, different mineral waters for sale, fountains and city pools , river, and drinking water with temperature near to boiling point.
 | [27] |
| 27. | **2011** | Oslo, NorwayNorwegian Veterinary institute | *M. avium* subsp.*hominissuis* | Formalin fixed, paraffin embedded cervical and mesenterial lymph nodes from tuberculin positive Serbian imported pigs of the Lithuanian herd* - Samples from the herd facilities-tapwater, peat, saw dust, water pipe.
 | [28] |
| 28. | 2008-2009**2011** | Mubende and Nakasongola districts located in central Ugandathe cattle corridor in Uganda- The sub-counties were Madudu and Kiyuni in Mubende and Nabiswera and Lwampanga in Nakasongola. | MAC | * Samples from water, soil and animal faeces collected from different households.
 | [29] |
| 29. | **2011** | Six fattening farms located in Central Spain. | *M. avium* subsp.*hominissuis* isolates | Granulomatous lesions in submandibular and mesenteric lymph nodes of pigs Environmental source: feed, sawdust and water from different locations, and from several humidified cellulose sheets acting as* filters in cooling systems.
 | [30] |
| 30. | **2010** | Midwest region of the United States | *M. avium**M. intracellulare**M. avium* subsp*paratuberculosis* | Drinking water biofilms to investigate* kitchen faucet from diff households receiving water from duff public systems (groundwater, surface water or both- chlorinated)
 | [31] |
| 31. | **2010** | Patient from Czech Republic Patient from Slovakia | *M. avium* subsp.*hominissuis**M. avium* subsp. *avium* | Tissue samples from Patients with cervical lymphadenitis- To identify possible sources of infection, seven samples from the patient’s environment-residence, soil samples from garden* -home garden, greenhouse, hen house.
 | [32] |
| 32. | **2010** | Majorca (Balearic Islands, Spain) | *M. avium* spp. *avium* | From the tissue samples with lesions of-common kestrel (Falco tinnunculus* scops owl (Otus scops)
* barn owl (Tyto alba)
* long-eared owl (Asio otus
* peregrine falcon (Falco peregrinus)
* booted eagle (Hieraaetus pennatus)
 | [33] |
| 33. | **2010** | Central Veterinary Institute of Wageningen UR, Lelystad, The Netherlands | *M. avium* | * Post-mortem mandibular lymph node inspection was performed on two separate deliveries of slaughter pigs from a single farm
 | [34] |
| 34. | **2009** | 1.Sawangi District Wardha, 2. Karanji Bhoge District Wardha,3. Nandori District Wardha, 4. Wakhed District Wardha and 5.Wani District Chandrapur, India | *M. avium* with other NTM | Environmental samples viz. soil, drinking water, and water from other sources were collected from the household and work area of five AIDS patients in whom NTM were isolated from clinical samples like blood and stool* -samples collected from 5 villages
 | [35] |
| 35. | **2008** | Han river, Seoul, Korea | MAC | Surface water samples collected monthly from the Han River and tap water samples at* the terminal sites of the distribution system.
 | [36] |
| 36. | 2002-samplin g**2008** | New York city, USA | *M. avium, M. intracellulare* | Samples collected from the residence’s bathroomThe regularly used shower head was unscrewed and sediment was transferred to a sterile container and the biofilm collected with a cotton swabs* Hot and cold water samples from bathroom taps
 | [37] |
| 37. | **2008** | Netherlands | 70%) were caused by*M. avium* subspecies *avium hominissuis* | Lymph node aspirates or surgically obtained tissue biopsies from children affected with lymphadenitis- Materials of pet birds from two patients diagnosed with M. avium-associated lymphadenitis were collected* Swabs were collected from the cloacae of the parakeets, and faeces were scraped from the bottom of the cages
 | [38] |
| 38. | 2004-2005**2008** | Kathmandu, Nepal | *M. avium* complex | * Sputum from HIV infected patients
 | [39] |
| 39. | **2008** | TB units of Moroto and Matany hospitalsin the Karamoja region of Uganda | *M. avium**M. intracellulare**M. avium* subsp.*hominissuis* | * Lymph node biopsies from patients with with cervical lymphadenitis
 | [40] |
| 40. | **2008** | 15 ecological zones of Texas | Johnne’s bacilli- *M. avium* subsp *paratuberculosis* | Serum samples were collected from cattle- sampling cattle in herds, cattle presented to a market, and cattle recognized to be clinically* ill
 | [41] |
| 41. | **2007** | Elazig province (located in Eastern Anatolia, Turkey) | *M. avium**M. intracellulare* | * DNA extracted from tuberculosis patients
 | [42] |
| 42. | **2007** | The Norwegian Institute of Public health | *M. avium* subsp.*hominissuis* | *M. avium* isolates collected from –humans (immune compromised patients with/without* HIV, non-immunecompromised patients
 | [43] |
|  |  | The National Veterinary Institute of Norway | *M. avium* subsp. *avium* | * including children with lymphadenitis, adults with pulmonary disease. Pigs from slaughter houses and wild birds
 |  |
| 43. | **2007** | Olive View – UCLA Medical Center, Southern California | *M. avium**M. intracellulare* | MAC isolates were provided by Olive View* – UCLA Medical Center. One hundred and sixty-three isolates were obtained from patient and environmental sources, and identified as *M. avium, M. intracellulare* Patient isolates, drinking water isolates, food isolates
 | [44] |
| 44. | **2006** | Austria | *M. avium* subsp. *avium**M. avium* subsp.*hominissuis**M. avium* subsp.*paratuberculosis* | * Austrian free-ranging red deer (*Cervus elaphus hippelaphus*.
 | [45] |
| 45. | **2006** | Commercial dairy operations, 40 miles from Copenhagen, DenmarkNational Animal Disease Center, Ames IA, USA (US) | *M. avium* subspecies*paratuberculosis* | * Blood samples (non-stimulated leukocytes) isolated from sub-clinical paraTB infected cows.
 | [46] |
| 46. | **2006** | Veterinary Research Institute, Brno, Czech republic | *M. avium* subsp.*avium*-serotype 1*M. avium* subsp. *hominissuis* serotype 4,8,9 | Tissue and feacal samples from birds- little egrets (*Egretta garzetta*), buff-backed herons (*Bubulcus ibis*), great white egret (*Egretta alba*), bittern (*Botaurus stellaris*) & birds of the family Threskiornithidae: sacred ibises (*Threskiornis aethiopicus*) ,spoonbills (*Platalea leucorodia*). further sample from the environment surrounding the aviaries* that housed these infected birds
 | [47] |
| 47. | 2**006** | Mycobacterial Clinical Service at the National Jewish Medical and Research Center, Denver, Colorado, US | *M. avium* and *M. intracellulare* | Two commercial potting soils were purchased and used in this study, Both contained sphagnum peat moss along with other ingredient* Mycobacterial isolates from respiratory specimens were obtained in the course of routine patient care
* potting soil samples collected by the individual patients with gardening history
 | [48] |
| 48. | 2**005** | Northern Ireland | *M. avium* subsp.*paratuberculosis* | * untreated water entering nine water treatment works (WTWs) over a 1-year period
 | [49] |
| 49. | **2005** | The University of Sydney, Camden, Australia | *M. avium* subsp.*paratuberculosis* | the survival of the organism was studied in 250 liters of dam water and sediment in large water troughs that were placed in either a semiexposed location or in a shaded* location and compared to survival in fecal material and soil in the shaded location
 | [50] |
| 50. | **2005** | Wyoming State VeterinaryLaboratory, Laramie, USA. | *M. avium* | from enteric lymph nodes sampled at* necropsy of a Shih Tzu-Poodle-cross.
 | [51] |
| 51. | **2005** | Veterinary Research Institute,Brno, Czech Republic | *M. avium* subsp. *avium**M. avium* subsp.*hominissuis* | * Tissue samples from pig organs fed with peat contaminated with *M. avium* and environment samples.
 | [52] |
| 52. | **2005** | Texas, US | *M. avium* subspecies*paratuberculosis* | * Blood collected from purebred cattle of 115 beef ranches.
 | [53] |
| 53. | **2005** | From various farms inSwitzerland | *M. avium* ssp.*paratuberculosis* | Faecal samples from commercial dairy* herds.
 | [54] |
| 54. | **2004** | Veterinary Research Institute, Brno, Czech Republic | *M. avium* subsp. *hominissuis*-serotype 6,8 | * Lymph node samples from pigs Environmental samples-sawdust used as bedding material, drinking water
 | [55] |
| 55. | **2004** | Ohio State University, Wooster, Ohio 44691, USA | *M. paratuberculosis**M. avium-M. intracellulare* complex | Fecal and tissue samples from both captive and free-ranging wild animal species throughout the United States were submitted* for radiometric mycobacterial culture
 | [56] |
| 56. | 1996-1998**2003** | Hospital de Clínicas, Universidade Estadual de Campinas (HC-UNICAMP), Campinas, SP, Brazil | *M. avium* | * Blood samples from AIDS patients exhibiting disseminated disease
 | [57] |
| 57. | **2001** | St. Louis USA | *M. avium* complex | The air above the pool (public warm water therapy pools) was sampled, liquid from the swirling aerosol collectors were also* sampled, pool environment
 | [58] |
| 58. | **2000** | Department of Pulmonary Medicine, National Dohoku Hospital, Hokkaido, Japan. | *M. avium* complex | * Sputum and gastric juice samples of patients with lung disease, dyspnea
 | [59] |
| 59.. | **2000** | 68 districts of the Czech republicThe Holstein herd, imported from DenmarkLimousine herd imported from Hungary | *M. avium* subspecies *paratuberculosis* strains | * Necroscopy specimens, tissue and facecal samples from wild ruminants
 | [60] |
| 60. | **1999** | France | *M. avium* | * Isolates from infected patients.
 | [61] |
| 61. | **1999** | Department of Respiratory Medicine, National Kumamotominami Hospital, Kumamoto 869-0524, Japan | *M.intracellulare* | * Sputum samples from patients suffering from lung disease.
 | [62] |
| 62. | **1998** | in Tokai, Kinki and Chugoku districts, Japan | *M avium**M. intracellulare*MAC like organisms*M. avium* serovars- 4,8,9,3, Darkin, 1 | soil samples collected* isolates from sputum, stool and blood and AIDS patients
 | [63] |
| 63. | 1994-1995**1997** | Bellevue Hospital Center in New York City | *M. avium* complex | Patients were included in this study if they had at least one positive culture for M tuberculosis from a pulmonmy source and two or more sputum cultures of MAC on at* least two separate occasions.
 | [64] |
| 64. | **1994** | Department of Clinical Microbiology, Westmead Hospital, New South Wales, Australia. | MAC subtypes Serovar 1,8, 21Mixed seovars 1-21 | * Specimens from blood, bone marrow, sterile sites, faeces, urine and respiratory specimens from AIDS patients
 | [65] |
| 65. | **1993** | Brno, Czech republic | *M. avium* serotype 2 | Samples collected from free living birds, and the environment from 6 poultry rearing* farms
 | [66] |
| 66. | **1993** | Brno, Czech republic | *M. avium* | * 218 organs and intestinal specimens of the collared turtle-doves and 22 specimens of turtle-doves taken in habitats with different epidemiological setting
 | [67] |
| 67. | **1993** | 11 different locations in Brno, Czech republic | *M avium* | * House-sparrows (*P. domesticus*) and mountain-sparrows (*P. montanus*)
 | [68] |
| 68. | **1993** | Brno, Czech republic | *M. avium* | Pheasant (*Phasianus colchicus*) and* partridge (*Perdix perdix*)
 | [69] |
| 69. | 1982-1991**1992** | Indiana, Boston, new York, California, Albany, San Francisco, Denver, Philadelphia, Chicago, Baltimore, Columbus,Washington DC, Texas, Ohio | MAC serovar 4>8>1>9>6>14>2 | * Cultures of samples from almost everybody site was obtained was patients with and without AIDS, respiratory sites, sterile body sites-blood, bone marrow, kidney, liver, lung, lymph nodes, spleen, cerebrospinal fluid
 | [70] |
| 70. | **1991** | Tokyo | *M. avium* complex*M. kansasii* | Sputum from patients with pulmonary* disease
 | [71] |
| 71.. | **1988** | Southeastern coastal region of Madagascar | *M. avium* | * A total of 18 sphagnum samples were collected
 | [72] |
| 72. | **1989** | Kekerengu, Marlborough,NewZealand | *M. avium* | Soil, tree debris, silage pits, water samples* collected from deer farms
 | [73] |
| 73. | 1985-1986**1989** | Commercial swine herds, Davis, California | MAC serovars-1, 4, 8, 9, the dual serovar 4/8, and an untypable serovar | * Tissue samples from pigs and their and their associated environment
 | [74] |
| 74. | **1988** | Department of Anaesthesia, Harvard Medical School,Boston, MA | *M. avium*-type 4 serovar | cold water taps and hot water taps, including shower heads of two temporarily vacant* hospital floors
 | [75] |
| 75. | 1968-1978**1981** | Transkei, Kwazulu, Gazankulu, Ciskei, Bothuthatswana, Lebowa- South Africa | 792 strains of the *Mycobacterium avium- intracellulare* complex | Samples from South African swine, feed material, bedding, from surrounding plants and soil* Samples were isolated from sputa of healthy adults in random-sample surveys undertaken in rural, black-homeland areas of South Africa
 | [76] |
| 76. | **1980** | basin of the Fitzroy River and its tributaries in central Queensland, coastal city of Rockhampton, southeastern Queensland city of Toowoomba | *Mycobacterium intracellulare and M. avium* | * Isolated from rainwater tanks situated in the basin of the Fitzroy River and its tributaries in central Queensland, 7 of 32 tanks situated in the hinterland of the coastal city of Rockhampton, and 2 of 32 tanks sampled repetitively in the southeastern Queensland city of Toowoomba
 | [77] |
| 77. | **2014** | Germany | *M. avium* (MAH) | * poultry, Humans, dogs
 | [78] |
| 78. | **1982** | Hungry | *M avium*, NTM | * birds, animals, humans NTM bacteria

(Crohns Disease) | [79] |
| 79. | **2004** | Italy | *M avium* (MAH) | * *patients*
 | [80] |
| 80. | **1989** | Sweden | *M avium* (MAH) | * *patients*
 | [81] |
| 81. | **2015** | Russia | *M avium* (MAH) | * *patients*
 | [82] |

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