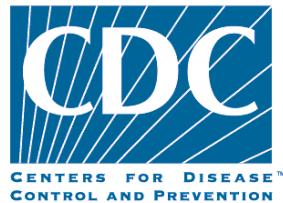


Location and Time to Epi (LATTE)

Algorithm

User's Manual

Version 1.0, Released December 15, 2020



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Introduction

The Location and Time to Epi algorithm, or LATTE, is a free analytic tool created in the programming language R [1] by staff of the Centers for Disease Control and Prevention (CDC) to facilitate the investigation of clusters of tuberculosis (TB) disease. No program files beyond a web browser need to be downloaded or installed on the user's computer to perform a LATTE analysis. LATTE automates the comparison of location/date information to determine when two persons were known or presumed to have had direct or indirect contact at a location and thus share an epidemiologic link. When at least one of those persons has infectious TB disease, transmission of *Mycobacterium tuberculosis* (the etiological agent of TB disease) to the other person can occur. If two persons share an epidemiologic link and it can be demonstrated that one person likely transmitted *M. tuberculosis* to the other person (e.g., by genotyping pathogen isolates from sputum samples), then those persons are said to share a transmission link. LATTE expedites the review of large contact databases created during TB contact investigations to allow rapid identification of contacts of greatest concern based on duration of overlap for timely follow-up to prevent additional transmission. Additionally, use of LATTE promotes the systematic formatting and organization of contact data and databases in ways that can simplify and expedite cluster and outbreak investigations.

Intended use

LATTE is available free from the CDC without warranty or guarantee of any kind as to the appropriateness of its application or the accuracy of resulting outputs. CDC technical assistance with LATTE may not always be available for all user analyses; the availability of these support services may be discontinued at any time.

LATTE is intended to be used by public health practitioners conducting TB contact investigations. Use of LATTE may be especially helpful during location-based contact investigations when lists of potential contacts associated with one or more locations are obtained (e.g., from enrollment lists for school courses,

client logs for homeless shelters, inmate manifests for correctional facilities) and must be analyzed. During location-based contact investigations involving large numbers of contacts, multiple locations, and potentially multiple different visits to or stays at a given location by individual contacts, the large volume of data can make analyses to identify the contacts at highest risk computationally difficult, time consuming, and prone to error, especially if done by hand. LATTE automates this analytic process, enabling rapid comparison of location/date information to determine when two persons were known or presumed to have had direct or indirect contact at a location and thus share an epidemiologic link. While LATTE can quickly identify these persons, investigators should always review and compare results of a LATTE analysis with other insights and exposure/transmission hypotheses generated using frontline epidemiologic and molecular investigation methods. Furthermore, LATTE outputs are only as good as the quality (e.g., accuracy, completeness) of the data used to generate them. For example, missing or incorrect location/date information (e.g., imprecisely calculated dates) may compromise the accuracy and value of LATTE results. Beyond being able to interpret LATTE outputs, users should become familiar with the algorithm's decision rules to understand the various ways that LATTE outputs are constrained by assumptions and limitations of the underlying analytic framework.

Within this user's manual, explicit names of variables appear in **green font**, explicit names of files, components of files (e.g., worksheets within Microsoft Excel files), webpages, and features of webpages (e.g., check boxes) appear in **blue font**, and hyperlinks appear as *underlined italicized* text.

Glossary

Case: a person infected with *M. tuberculosis*, the etiological agent of TB disease, who is experiencing TB disease. Note that more accurately, a case refers to an instance of disease in a person (i.e., "patient X had a case of TB disease in 2018"). To be consistent with more colloquial usage of the term, case is used to refer to a person rather than an episode of disease within LATTE and associated documentation (including this user's manual).

Cluster: a group of cases that are known or presumed to be epidemiologically linked by recent *M. tuberculosis* transmission (e.g., based on results of genotyping of pathogen isolates from sputum samples).

Contact: a person with known or presumed exposure to an infectious case. Contacts can be identified through name-based (i.e., one person names another) and location-based (i.e., records or interview

findings indicate that persons were in the same place (e.g., homeless shelter, workplace) at the same time) methods. The goal of a contact investigation is to generate a list of contacts for follow up.

Epidemiologic (epi) link: two persons known or presumed to have had direct or indirect contact at a location are said to share an epidemiologic, or epi, link. Epi link is a commonly used shorthand for the formal term epidemiologic link. Epi links are identified during contact investigations and can vary in strength based on the proximity, duration, or frequency of contact between the persons. As part of LATTE analyses the strength of epi links is assigned based on the duration that two persons overlapped and the confidence the user has in the dates of overlap. For additional information about defining epi link strength see Appendix 2 *below*.

Infectious period (IP): the period during which a case is infectious. The precise start and end dates of infectious periods generally cannot be determined precisely and instead are estimated. For additional information about estimating the start and end dates of infectious periods see *Figure 8*.

Transmission link: two persons share a transmission link when they share an epi link, the timing of their overlap was during the infectious period of one of the persons (i.e., case), and there is evidence (e.g., results of genotyping of pathogen isolates from sputum samples from both persons) that this person transmitted *M. tuberculosis* to the other person.

Acronyms

The following is a list of acronyms that appear in this user's manual

CDC: U.S. Centers for Disease Control and Prevention

CITGO: CDC Information Technology on the Go

DTBE: Division of Tuberculosis Elimination

IP: Infectious period

LATTE: Location and Time to Epi

LITT: Logically Inferred Tuberculosis Transmission

MMWR: Morbidity and Mortality Weekly Report

NNDSS: National Notifiable Diseases Surveillance System

NTCA: National Tuberculosis Controllers Association

OAMD: Office of Advanced Molecular Detection

OCIO: Office of the Chief Information Officer

PII: Personally identifiable information

SAMS: Secure Access Management System

TB: tuberculosis

TB GIMS: Tuberculosis Genotyping Information Management System

VPN: virtual private network

Algorithm overview

Four types of analyses can be performed using LATTE.

1. IP epi link analysis with date data

A LATTE IP epi link analysis with date data identifies pairs of persons who were in the same location on the same day(s) during the infectious period (IP) of one of the persons (here, cases) for a cumulative number of days (consecutive or nonconsecutive) equal to or exceeding the [overlap threshold](#) (number of days two persons must overlap in a location and during the IP to form an IP epi link) set by the user. It can include contacts but must include at least one case; in addition to location and date data, data on the start and end dates of the IP of at least one case included in the analysis are required. Multiple

person/location combinations can be included in a single analysis and the user specifies their confidence (“Certain” or “Uncertain”) in the start and end dates associated with each person/location combination. The IP epi link is based on the total number of days of overlap during an IP regardless of whether the overlap(s) occurred in one continuous time period or several discontinuous time periods in one or more locations. If a case and a contact overlapped at a location during the case’s IP for a duration equal to or exceeding the **overlap threshold** set by the user, LATTE will characterize their IP epi link as Definite or Probable based on the confidence in location start and end dates specified by the user (*Figure 1*).

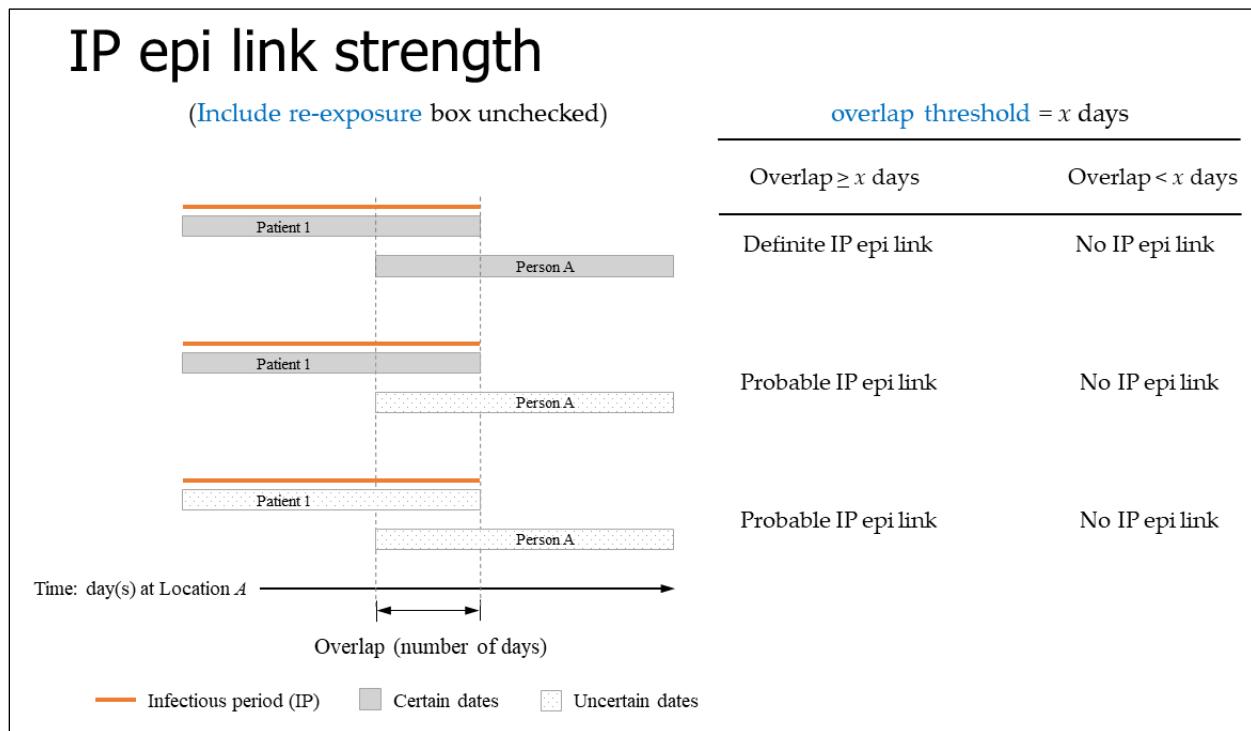


Figure 1. Schematic showing LATTE decision rules for a LATTE IP epi links analysis with date data in which re-exposure is not included (Include re-exposure box unchecked).

If a case and a contact overlapped at a location during the case’s IP for a duration less than the **overlap threshold** set by the user, LATTE will not consider those persons to be IP epi linked at that location. An IP epi link analysis can be used to find all possible links between pairs of persons when at least one of those persons is a case.

If the pair of persons that overlapped at a location are both cases, the user can specify whether LATTE should consider the possibility of re-exposure as part of an IP epi link analysis. The default setting for an

IP epi link analysis is to exclude re-exposure (i.e., the **Include re-exposure** box is unchecked). This means that for a pair of cases, the IP epi link analysis will not count any overlap at a location that occurred after the end of the earlier infectious period as part of a potential IP epi link, even if that overlap occurred during the later infectious period (*Figure 2*). If the user overrides the default setting for an IP epi link analysis by checking the **Include re-exposure** box, the IP epi link analysis will count any overlap at a location as part of a potential IP epi link. Using the example illustrated in *Figure 2*, the overlap between Patient 1 and Patient 2 (both cases) occurred after the IP for Patient 1 has ended. If re-exposure is included, LATTE will consider the possibility of an IP epi link between Patient 1 and Patient 2 if their overlap occurred during the IP of Patient 2 (i.e., Patient 1 could potentially be re-exposed and reinfected). This scenario would be most relevant if the user is trying to identify persons who require evaluation, or if the user has other reasons to be concerned about re-exposure. In contrast, if re-exposure is not included, LATTE will not consider the possibility of an IP epi link between Patient 1 and Patient 2 if their overlap occurred after the IP of Patient 1 has ended, even if that overlap occurred during the IP of Patient 2. This scenario would be most relevant if the user is looking for possible transmission between cases.

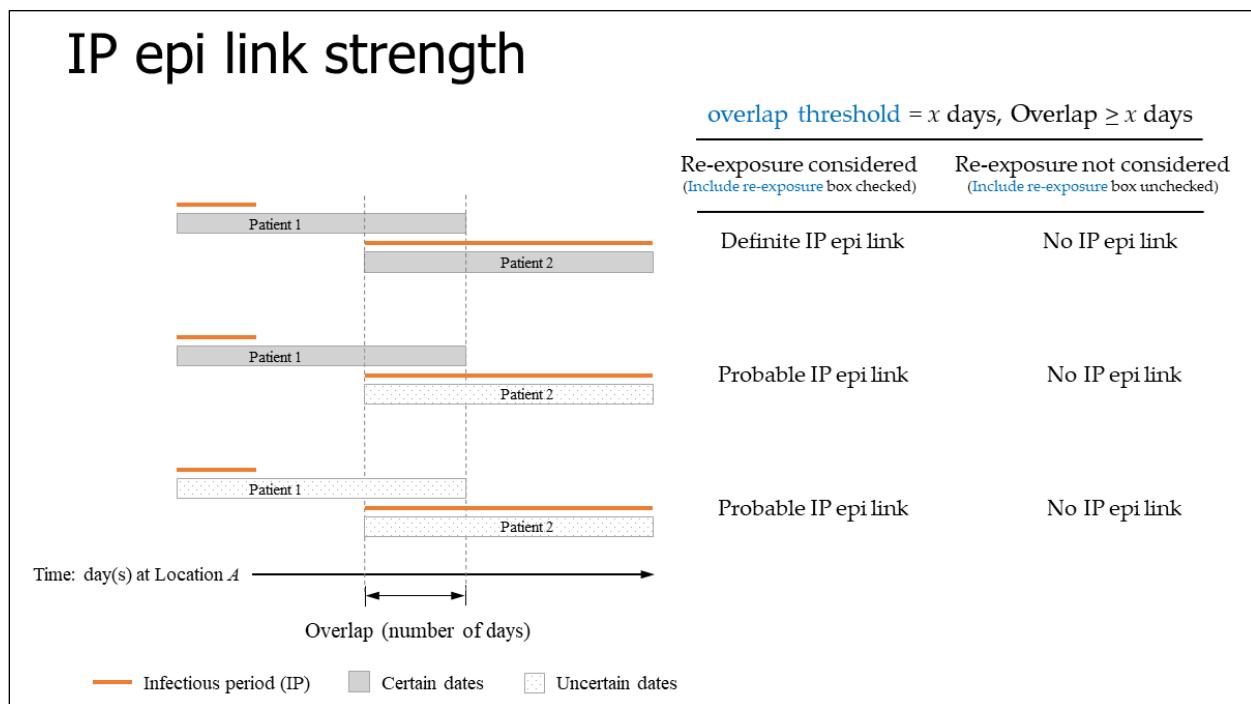


Figure 2. Schematic showing comparison of LATTE decision rules for LATTE IP epi link analysis with date data in which re-exposure is or is not included.

2. Epi link analysis with date data

A LATTE epi link analysis with date data identifies pairs of persons (cases or contacts) who were in the same location on the same day(s) for a cumulative number of days (consecutive or nonconsecutive) equal to or exceeding the [overlap threshold](#) (number of days two persons must overlap in a location to form a definite or probable epi link) set by the user. It can include contacts or cases or both and requires only location and date data. Multiple person/location combinations can be included in a single analysis, and the user specifies their confidence (“Certain” or “Uncertain”) in the start and end dates associated with each person/location combination. The epi link is based on the total number of days of overlap regardless of whether the overlap(s) occurred in one continuous time period or several discontinuous time periods in one or more locations. If a pair of persons overlapped at a location for a duration equal to or exceeding the [overlap threshold](#) set by the user, LATTE will characterize their epi link as Definite or Probable based on the confidence in location start and end dates specified by the user (*Figure 3*).

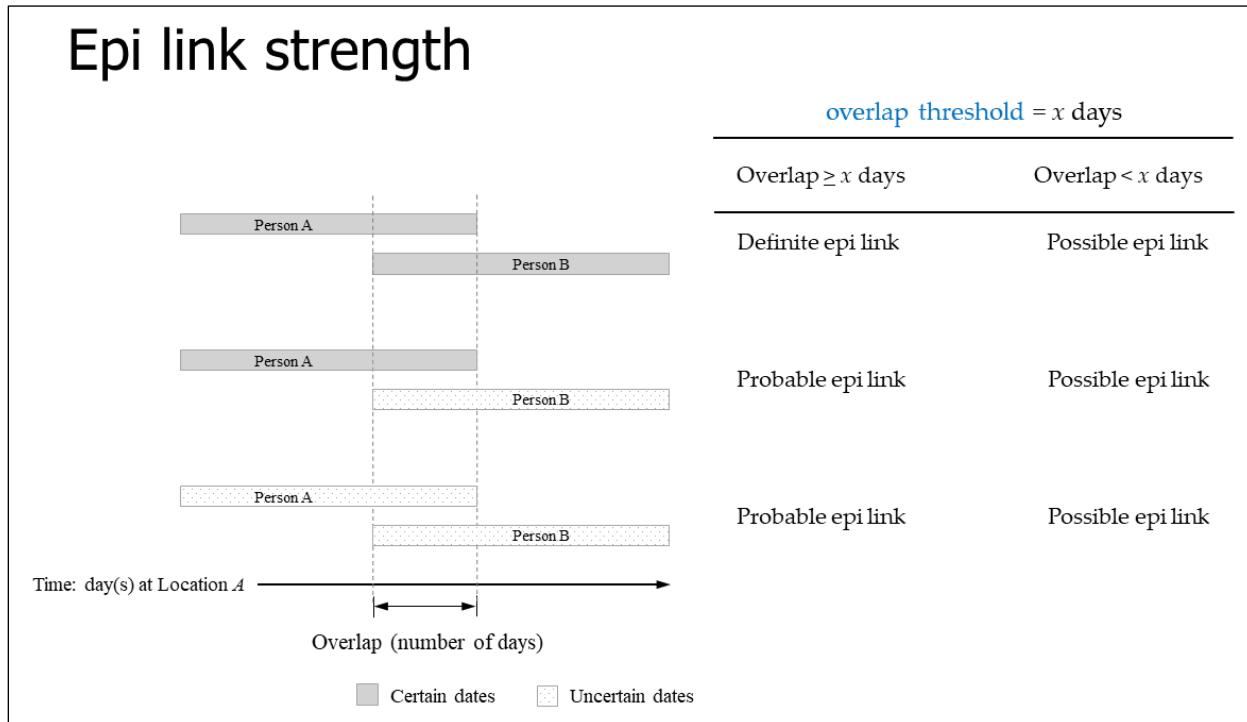


Figure 3. Schematic showing LATTE decision rules for a LATTE epi link analysis with date data.

If a pair of persons overlapped at a location for a duration less than the [overlap threshold](#) set by the user, LATTE will characterize their epi link as Possible. If a pair of persons did not overlap at a location,

LATTE will not consider those persons to be epi linked at that location. An epi link analysis can be used to find all possible links between pairs of persons, regardless of whether those persons are cases or contacts and without regard to anyone's infectious period.

3. Epi link analysis without date data

A LATTE epi link analysis without date data is used to generate a list of all possible pairs of persons (cases or contacts) who overlapped at one or more locations without dates. The user provides a list of all persons known or presumed to have been associated with each other at each location included in an analysis; information on the timing or duration of these overlaps is not needed. Based on this list of persons in locations, LATTE outputs a list of all pairs of persons in each location (i.e., a list of all location-specific epi links). Additionally, the user can associate an epi link strength with each person pair/location combination. A single epi link strength can be assigned to all person pairs regardless of location, or the user can provide location-specific epi link strengths that LATTE will assign to each person pair based on the associated location. This option allows users to convert lists of people into epi links without requiring date data.

4. Gantt chart analysis

A LATTE Gantt chart analysis is used to generate charts to visualize dates of stays in locations and infectious periods. The user provides lists of dates of stays in locations or dates of infectious periods, or both, and LATTE outputs one or more charts in Gantt chart format that can be used to quickly determine when persons had overlapping stays at one or more locations and especially when those overlaps might have coincided with a case's infectious period.

Accessing the algorithm

LATTE is available as an interactive webpage hosted by the CDCs' Office of Advanced Molecular Detection (OAMD). Users can access LATTE via a web browser by logging into the OAMD web portal (*Figure 4*), an online clearinghouse for select digital products and services curated by OAMD. For additional information about how to access the OAMD web portal, see Appendix 1 *below*.

Once logged into the OAMD web portal (*Figure 4*), users will see their approved list of accessible OAMD applications; each application will appear as a visual tile. LATTE is accessed via the **TB**

molecular epidemiology tile (A in *Figure 4*); click on this tile to navigate to the Algorithms for TB molecular epidemiology analysis webpage (*Figure 5*). If this tile is not present, click on the Request access button on the left of the screen (B in *Figure 4*), then click on the “TB molecular epidemiology” option in the left side of the pop-up window to move it to the right side (“Requested”) of the pop-up window, and then click on the Go button at the top right of the pop-up window. If the tile is still not present or working properly, users should send an email to their Division of Tuberculosis Elimination (DTBE) point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a DTBE point of contact for LATTE analyses, to TBGenotyping@cdc.gov to request assistance. Note that CDC technical assistance may not always be available for all user analyses and that the availability of these support services may be discontinued at any time.

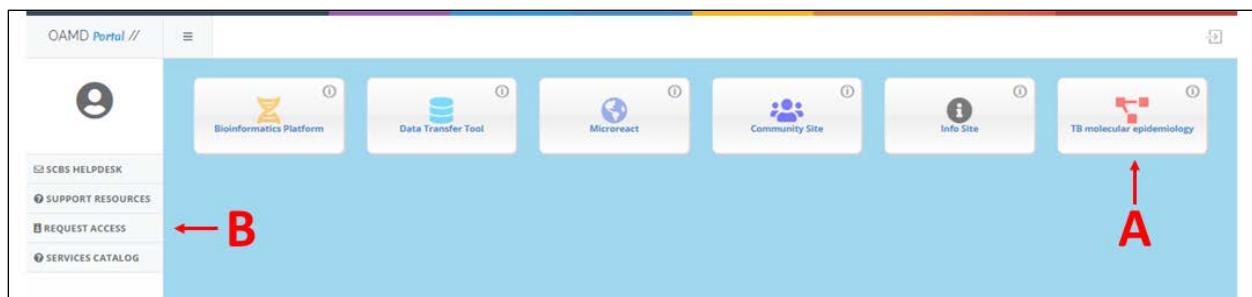


Figure 4. Annotated screenshot of the OAMD web portal. Annotation appears in red.

Algorithms for TB molecular epidemiology analysis

Logically Inferred Tuberculosis Transmission (LITT)
LITT is an algorithm that can be used to integrate whole genome sequencing, clinical, and epidemiological data to identify and rank potential sources for tuberculosis cases.
[LITT](#)

Location And Time To Epi (LATTE)
LATTE identifies all overlaps in space and time from a list of dates that cases (or contacts) were in a particular location, then combines that with infectious periods (IP) to identify and categorize epi or IP epi links.
[LATTE](#) ← A

Figure 5. Annotated screenshot of the Algorithms for TB molecular epidemiology analysis webpage. Annotation appears in red.

On the [Algorithms for TB molecular epidemiology analysis](#) webpage, users will see links to TB-related data analysis algorithms and associated files and documentation. LATTE is accessed via the [LATTE](#) hyperlink (A in *Figure 5*), which will direct users to the LATTE online user interface.

LATTE IP epi link analysis with date data

A. *Preparing data*

1. Data overview

Two types of data, each uploaded to LATTE as a separate input file, are required for a LATTE IP epi link analysis with date data.

1. [Table of dates in locations](#): this input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations) and the user's confidence in this location/date information.
2. [Table of infectious periods](#): this input file contains information on the estimated infectious period (IP) start and end dates for one or more cases included in an analysis.

Separate input file templates (Microsoft Excel files) are available for the [Table of dates in locations](#) and [Table of infectious periods](#) input files. These templates can be downloaded from the [DTBE TB genotyping](#) webpage, which can be accessed using this [link](#) or through a link on the LATTE online user interface (see *Figure 10*). Each template file contains a data worksheet (named [data](#)) into which the data to be analyzed are entered, and a metadata worksheet (named [metadata](#)) that provides information about the names, definition, and formatting of variables included in the [data](#) worksheet. The [data](#) worksheet must be in the first position (i.e., to the left of the [metadata](#) worksheet) as this is the worksheet position from which LATTE pulls data for an analysis.

Note: all screenshots and discussion of analytic outputs presented in this user's manual are based on LATTE analyses of the input files associated with [LATTE training dataset 01](#) and [LATTE training dataset 02](#). These analyses can be replicated by downloading the [LATTE training dataset 01](#) and [LATTE training dataset 02](#) input files (see section on training datasets *below*) and using them to perform LATTE analyses as described in this user's manual. Additionally, screenshots of the LATTE online user interface

presented in this user’s manual were taken while running LATTE in the Google Chrome web browser. Note that LATTE seems to consistently perform with few if any issues when used in the Chrome web browser; the LATTE online user interface may appear slightly different in other browsers.

IMPORTANT: DO NOT INCLUDE PERSONALLY IDENTIFIABLE INFORMATION (PII) ABOUT CASES, CONTACTS, OR LOCATIONS

When populating the [Table of dates in locations](#) and [Table of infectious periods](#) input files, deidentified data should be used. Personally identifiable information about cases, contacts, or locations should never be uploaded to CDC servers as part of a LATTE analysis. This is because any information uploaded to a CDC server might be considered a federal record and therefore be subject to disclosure under the federal Freedom of Information Act or other laws. Do not use the real and complete names of cases or contacts as values for [ID](#) or the real and complete names of locations (e.g., schools, shelters, workplaces) as values for [Location](#), especially in geographically small areas. Further, be mindful of situations in which combinations of data can allow for personal identification. Users should endeavor to deidentify potentially identifying information whenever possible (e.g., if the location is a restaurant, consider assigning an identifier like “Restaurant A” or even “Location A” instead of using the name of the restaurant). A separate key to allow translation of generic identifiers back to actual names can be maintained by the user as a separate file that is stored locally (i.e., not on a CDC server).

2. Table of dates in locations

The [Table of dates in locations](#) input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations). A screenshot of the [Table of dates in locations](#) input file from [LATTE training dataset 01](#) provides an example of how a populated [data](#) worksheet might appear (*Figure 6*).

	A	B	C	D	E
1	ID	Location	Location start	Location end	Confidence
2	Case 1	Homeless shelter A	09/01/18	09/30/18	Certain
3	Case 2	Homeless shelter A	11/01/18	11/05/18	Uncertain
4	Case 2	Homeless shelter A	11/06/18	11/16/18	Certain
5	Case 3	Homeless shelter A	09/28/18	09/28/18	Uncertain
6	Case 3	Homeless shelter A	09/29/18	10/04/18	Certain
7	Case 3	Homeless shelter A	10/20/18	10/20/18	Uncertain
8	Case 3	Homeless shelter A	11/03/18	11/03/18	Uncertain
9	Case 3	Homeless shelter A	11/09/18	11/09/18	Uncertain
10	Case 3	Homeless shelter A	11/11/18	11/12/18	Uncertain
11	Case 4	Homeless shelter A	09/22/18	09/23/18	Uncertain
12	Case 4	Homeless shelter A	09/24/18		Certain
13	Case 4	Homeless shelter A	09/25/18	09/30/18	Uncertain
14	Case 4	Homeless shelter A	11/02/18	11/02/18	Uncertain
15	Case 4	Homeless shelter A	11/03/18	11/03/18	Certain
16	Case 4	Homeless shelter A	11/04/18	11/05/18	Uncertain
17	Contact 1	Homeless shelter A	10/03/18	11/03/18	Certain
18	Contact 2	Homeless shelter A	09/20/18	09/20/18	Certain
19	Contact 2	Homeless shelter A	09/24/18	10/04/18	Certain
20	Contact 3	Homeless shelter A	09/02/18	09/10/18	Certain

Figure 6. Screenshot of a portion of the [data](#) worksheet in the [LATTE training dataset 01 Table of dates in locations](#) input file.

The [data](#) worksheet in the [Table of dates in locations](#) input file includes five required variables (green columns) described below.

Required variables (green columns):

1. **ID:** unique person (case or contact) identifier. If a cell in the **ID** column is left blank, LATTE will delete the associated row of data during the analysis. Note that values of **ID** must match exactly in all applicable rows and input files (i.e., in the [Table of dates in locations](#) and [Table of infectious periods](#)

input files, if both are included in a LATTE analysis) for LATTE to consider these data to be associated with the same person. **Do not include personally identifiable information about cases or contacts.**

2. **Location:** location with which the person corresponding to the specified **ID** was associated. Note that values of **Location** must match exactly in all applicable rows for LATTE to consider these data to be associated with the same location. If a cell in the **Location** column is left blank, the cell will remain blank and LATTE will treat that cell as if it contains the value of [blank]. In other words, LATTE will consider all cells left blank to contain the same value for **Location**. **Do not include identifiable information about locations.**
3. **Location start:** start date of the period of time that the person corresponding to the specified **ID** was associated with the specified **Location**. The format for values is MM/DD/YY. If a cell in the **Location start** column is left blank, LATTE will delete the associated row of data during the analysis.
4. **Location end:** end date of the period of time that the person corresponding to the specified **ID** was associated with the specified **Location**. If a cell in the **Location end** column is left blank, LATTE will assign the associated value of **Location start** during the analysis (i.e., LATTE will assume the person was only in the location for one day). Thus, if the person corresponding to the specified **ID** was associated with the specified **Location** for only one day, the cell in the **Location end** column can be left blank. The format for values is MM/DD/YY.
5. **Confidence:** confidence the user has in values for **Location start** and **Location end**. Options are “Certain” (user is certain of values for **Location start** and **Location end**) and “Uncertain” (user is uncertain of values for **Location start** or **Location end** or both). If a cell in the **Confidence** column is left blank, LATTE will assign a default value of “Uncertain” during the analysis. The “Uncertain” option should be used when dates in a location can only be associated with a general period of time rather than for specific dates (e.g., a person included in a LATTE analysis indicates that they “stayed at the shelter for a few days in the first half of May”).

3. Table of infectious periods

The **Table of infectious periods** input file contains information on the estimated infectious period start dates and infectious period end dates for one or more persons (here, cases) included in an analysis. A screenshot of the **Table of infectious periods** input file from **LATTE training dataset 01** provides an example of how a populated **data** worksheet might appear (*Figure 7*).

	A	B	C
1	ID	Infectious period start	Infectious period end
2	Case 1	09/15/18	02/23/19
3	Case 2	10/16/18	04/11/19
4	Case 3	06/03/15	03/12/16
5	Case 4	04/24/16	01/27/17

Figure 7. Screenshot of a portion of the [data worksheet](#) in the [LATTE training dataset 01 Table of infectious periods](#) input file.

The [data](#) worksheet in the [Table of infectious periods](#) input file includes three required variables (green columns) described below.

Required variables (green columns):

1. **ID:** unique person (here, case) identifier. If a cell in the **ID** column is left blank, LATTE will delete the associated row of data during the analysis. Note that values of **ID** must match exactly in all applicable rows and input files (i.e., in the [Table of dates in locations](#) and [Table of infectious periods](#) input files, if both are included in a LATTE analysis) for LATTE to consider these data to be associated with the same person. **Do not include personally identifiable information about cases.**
2. **Infectious period start:** estimated start date of a case's infectious period. This variable is only required and can only be estimated for infectious cases (i.e., adult cases with pulmonary or laryngeal disease). To estimate **Infectious Period Start**, use recommendations from the National Tuberculosis Controllers Association (NTCA) and CDC [2] summarized in [*Figure 8*](#).

TABLE 2. Guidelines for estimating the beginning of the period of infectiousness of persons with tuberculosis (TB), by index case characteristic

Characteristic				
TB symptoms	AFB* sputum smear positive	and	Cavitory chest radiograph	Recommended minimum beginning of likely period of infectiousness
Yes	No	and	No	3 months before symptom onset or first positive finding (e.g., abnormal chest radiograph) consistent with TB disease, whichever is longer
Yes	Yes	or	Yes	3 months before symptom onset or first positive finding consistent with TB disease, whichever is longer
No	No	and	No	4 weeks before date of suspected diagnosis
No	Yes	or	Yes	3 months before first positive finding consistent with TB

SOURCE: California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. Contact investigation guidelines. Berkeley, CA: California Department of Health Services; 1998.

* Acid-fast bacilli.

Figure 8. Screenshot of Table 2 from Guidelines for the investigation of contacts of persons with infectious tuberculosis (TB) [2] showing decision rules for how to estimate the infectious period start date based on case characteristics.

Infectious period start is generally estimated using characteristics of the TB disease at diagnosis (e.g., acid-fast bacilli (AFB) smear positivity, lung findings and the date of symptom onset (e.g., cough onset) or, for persons without reported symptoms, the date of the first positive finding consistent with TB disease (e.g., abnormal chest x-ray). The format for values is MM/DD/YY. If a cell in the **Infectious period start** column is left blank, LATTE will delete the associated row of data. Note, however, that the person (case) associated with this deleted row of data can still be included in the overall analysis based on any associated value(s) of **Location**, **Location start**, **Location end**, and **Confidence** in the **Table of dates in locations**.

3. **Infectious period end:** estimated end date of a case's infectious period. This variable is only required and can only be estimated for infectious cases (i.e., cases with pulmonary or laryngeal disease). To calculate **Infectious Period End**, use recommendations from the NTCA and CDC [2], specifically:

"The infectious period is closed when the following criteria are satisfied: 1) effective treatment (as demonstrated by susceptibility results) for ≥2 weeks; 2) diminished symptoms; and 3) mycobacteriologic response (e.g., decrease in grade of sputum smear positivity detected on sputum-smear microscopy)...A patient returning to a congregate living setting or to any setting in which susceptible persons might be exposed should have at least three consecutive negative sputum AFB smear results from sputum collected >8 hours apart (with one specimen collected during the early morning) before being considered noninfectious."

For contact investigation purposes, the infectious period can also end when the case is isolated under airborne infection isolation precautions, even if not all the criteria above have been met. This is because these precautions limit the case's ability to transmit *M. tuberculosis* to additional contacts.

The format for values is MM/DD/YY. If a cell in the **Infectious period end** column is left blank, LATTE will delete the associated row of data. Note, however, that the person (case) associated with this deleted row of data can still be included in the overall analysis based on any associated value(s) of **Location**, **Location start**, **Location end**, and **Confidence** in the [Table of dates in locations](#).

B. Performing an IP epi link analysis with date data

A LATTE IP epi link analysis with date data is performed on the [Link analysis with date data](#) tab of the LATTE online user interface ([Figure 9](#)). This is the first (left to right) of three tabs on the online user interface (A in [Figure 9](#)).

A → [Link analysis with date data](#) [Link analysis without date data](#) [Gantt charts only](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs
Warning: do not upload personally identifiable information (PII)
Table of dates in locations (required)
[Browse...](#) No file selected

Set up link definitions
Type of link
 Epi link (all overlaps)
 IP epi link (only overlaps during an IP)
Overlap threshold
Number of days two people must overlap in a location to form a definite or probable epi link.

Set up Gantt chart outputs
 Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs
Name prefix for output files

[Clear inputs](#)

[Run](#)

Figure 9. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface. Annotation appears in red.

Clicking on the [Help](#) (“?”) button (B in [Figure 9](#)) will reveal a pop up window (A in [Figure 10](#)) that provides links to LATTE supporting material including the LATTE R source code (hosted on the [TB](#)

molecular epidemiology GitHub webpage) and a LATTE user's manual, training presentation, input file templates (see section on preparing data *above*), and training datasets (see section on training datasets *below*) (hosted on the DTBE TB genotyping webpage). Alternatively, the TB molecular epidemiology GitHub webpage can also be accessed using this [link](#) and the DTBE TB genotyping webpage can also be accessed using this [link](#).

The screenshot shows the 'Location And Time To Epi (LATTE)' interface. On the left, there are three tabs: 'Link analysis with date data' (selected), 'Link analysis without date data', and 'Gantt charts only'. Below the tabs, there are sections for 'Set up inputs' (with a warning about PII), 'Set up link definitions' (radio buttons for 'Epi link (all overlaps)' and 'IP epi link (only overlaps during an IP)'), and 'Set up Gant' (checkboxes for generating location and IP Gantt charts, with 'Day' and 'Week' selected). In the center, there is a 'Set up outputs' section with a 'Name prefix for output files' input field and a 'Clear inputs' button. At the bottom is a large blue 'Run' button. A red annotation 'A→' points to the 'Help' button in the top right corner, which is highlighted in the pop-up window.

Figure 10. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing the pop-up window revealed by clicking the [Help](#) button. Annotation appears in red.

1. Set up inputs

Both a [Table of dates in locations](#) and a [Table of infectious periods](#) input file are required to perform a LATTE IP epi link analysis with date data. To upload a [Table of dates in locations](#) input file, click the [Browse](#) button under “Table of dates in locations (required)” on the left of the screen (A in *Figure 11*) and select the [Table of dates in locations](#) input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer in any drive or folder that can be accessed via the finder). To upload a [Table of infectious periods](#) input file, click the [Browse](#) button under “Table of infectious periods

(IP)” on the left of the screen (B in *Figure 11*) and select the Table of infectious periods input file from the finder window.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only ?

Identify epi links based on overlaps in dates of people in locations

Set up inputs
Warning: do not upload personally identifiable information (PII)
Table of dates in locations (required)
A → Browse... No file selected

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)
B → Browse... No file selected

Set up link definitions
Type of link
 Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold
Number of days two people must overlap in a location to form a definite or probable epi link.


Set up Gantt chart outputs
 Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs
Name prefix for output files

Figure 11. Annotated screenshot of the **Link analysis with date data** tab of the LATTE online user interface showing features to set up inputs. Annotation appears in red.

Once the **Table of dates in locations** and a **Table of infectious periods** input files have been successfully uploaded, the file names will appear in the box to the right of the associated **Browse** button and a hatched blue bar reading “Upload complete” will appear below the box (*Figure 12*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_I Upload complete

Set up link definitions

Type of link
 Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold
Number of days two people must overlap in a location to form a definite or probable epi link.


Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

[Clear inputs](#) [Run](#)

Figure 12. Screenshot of the [Link analysis with date data tab](#) of the LATTE online user interface showing successfully uploaded [Table of dates in locations](#) and [Table of infectious periods](#) input files.

2. Set up outputs

After uploading a [Table of dates in locations](#) and a [Table of infectious periods](#) input files, set up outputs by assigning a [Name prefix for output files](#) generated by the analysis.

1. **Name prefix for output files:** The text entered here (A in *Figure 13*) will form the prefix for the name of the zipped folder that is generated by the analysis and each of the LATTE output files contained within it. Additionally, LATTE will append the text “LATTE” to the name prefix when naming the folder and files. For example, if the text “Example” is entered, the zipped folder generated by the associated LATTE analysis will be named “ExampleLATTE,” and the names of each of the output files contained within it will begin with “ExampleLATTE.” If this field is left blank, output files will not be assigned a name prefix.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.



Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

A → Example Clear inputs Run

Figure 13. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing features to set up outputs. Annotation appears in red.

3. Set up link definitions

After setting up inputs and outputs, set up link definitions by selecting the appropriate [Type of link](#) and desired [overlap threshold](#) for the LATTE IP epi link analysis with date data.

1. [Type of link](#): To perform a LATTE IP epi link analysis with date data, select [IP epi link](#) (A in *Figure 14*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T
Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

A → 

Overlap threshold

Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.

B → 
 30

C → 
 Include re-exposure
 For case-case overlaps, consider re-exposure regardless of which IP comes first

Set up Gantt chart outputs

Generate location Gantt chart(s)
 Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
 Select time interval(s):
 Week
 Day
 Month

Set up outputs

Name prefix for output files

Example

Clear inputs

Run

Figure 14. Annotated screenshot of the **Link analysis with date data** tab of the LATTE online user interface showing features to set up link definitions. Annotation appears in red.

2. **Overlap threshold:** for a LATTE IP epi link analysis with date data, this slider (B in *Figure 14*) is used to set the number of days persons included in the analysis must overlap with each other in a location and during and an IP to form a definite or probable IP epi link. The default value is two days but can be adjusted by the user to vary between zero and 30 days. In practice, an **overlap threshold** value of two means that if two persons overlap for two or more days in a location during the IP of one of the persons, LATTE will consider it possible for those persons to have an IP epi link associated with that location. In contrast, if the overlap is for fewer than two days, LATTE will not consider it possible for those persons to have an IP epi link associated with that location.
3. **Include re-exposure:** this box (C in *Figure 14*) appears when **IP epi link** is selected for **Type of link** (A in *Figure 14*). It is used to specify whether LATTE will include re-exposure regardless of which IP comes first when two cases overlap (i.e., include re-exposure of a previously infected person as a potential IP epi link). The default value for **Include re-exposure** is for the box to be unchecked (i.e., re-exposure excluded).

4. Set up Gantt chart outputs

After setting up link definitions, set up Gantt chart outputs using check boxes to select the desired type(s) of Gantt chart(s), if any, to be output by the analysis and the time interval(s) (i.e., temporal resolution) for each type of chart. Note that including Gantt chart outputs as part of a LATTE analysis can significantly increase the amount of time required to complete the analysis when the volume of included date data is large.

1. Location Gantt charts: location Gantt charts facilitate visualization of dates of stays in locations (and estimated dates of infectious periods if a [Table of infectious periods](#) input file was uploaded). Check the [Generate location Gantt chart\(s\)](#) box (A in *Figure 15*) if one or more location Gantt charts are desired. When this box is checked, the time interval(s) (i.e., temporal resolution) for the location Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s).
2. IP Gantt charts: IP Gantt charts facilitate visualization of estimated dates of infectious periods. Check the [Generate IP Gantt chart\(s\)](#) box (B in *Figure 15*) if one or more IP Gantt charts are desired. When this box is checked, the time interval(s) (i.e., temporal resolution) for the IP Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01.T
Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01.T
Upload complete

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.



Include re-exposure
For case-case overlaps, consider re-exposure regardless of which IP comes first.

Set up Gantt chart outputs

A → Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

B → Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

[Clear inputs](#)

Set up outputs

Name prefix for output files
Example

Run

Figure 15. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing features to set up Gantt chart outputs. Annotation appears in red.

5. Initiating an analysis

Once the [Table of dates in locations](#) and [Table of infectious periods](#) input files have been successfully uploaded and analysis parameters have been set, click on the [Run](#) button (A in *Figure 16*) to initiate the LATTE IP epi link analysis with date data. If the analysis is proceeding successfully, a progress bar will appear in the bottom right corner of the screen above text that reads “Running LATTE” (B in *Figure 16*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_I Upload complete

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.



Include re-exposure
For case-case overlaps, consider re-exposure regardless of which IP comes first

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Name prefix for output files

Example

Clear inputs

A → Run

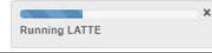
B → 

Figure 16. Annotated screenshot of the **Link analysis with date data** tab of the LATTE online user interface showing an analysis in progress and proceeding successfully. Annotation appears in red.

When the analysis is complete, text that reads “Analysis complete” and a [Download Results](#) button will appear beneath the [Run](#) button (A in *Figure 17*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01.T
Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01.T
Upload complete

Set up link definitions

Type of link
 Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold
Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.
 0 2 30

Include re-exposure
For case-case overlaps, consider re-exposure regardless of which IP comes first

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

[Clear inputs](#)

[Run](#)

Analysis complete

A→ [Download Results](#)

Figure 17. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface after successful completion of a LATTE analysis. Annotation appears in red.

After clicking on the [Download Results](#) button, an icon of a zipped download file will appear in the bottom left hand corner of the screen if you are using the Google Chrome browser (A in [Figure 18](#)). Other browsers might have a different way of indicating that a file has been downloaded. Click on this icon to choose the location where the zipped folder containing the results of the LATTE IP epi link analysis with date data should be saved. Note that after clicking on the [Download Results](#) button, the specific steps to follow to save results of the analysis, and the appearance of the screen, may vary slightly depending on the browser and browser settings being used.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up link definitions

Type of link
 Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold
Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.


Include re-exposure
For case-case overlaps, consider re-exposure regardless of which IP comes first.

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s)
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s)
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

Clear inputs Run Download complete

[Download Results](#)

ExampleLATTE.zip  Show all X

Figure 18. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface after successful completion of a LATTE analysis and clicking on the [Download Results](#) button. Annotation appears in red.

If the LATTE IP epi link analysis with date data cannot be successfully completed for some reason, an error message may appear. For example, the message “No location data. Please input a location table” will appear below the [Run](#) button (A in *Figure 19*) if a [Table of dates in locations](#) input file was not successfully uploaded.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap each other and an IP to form a definite or probable IP epi link.



Include re-exposure
For case-case overlaps, consider re-exposure regardless of which IP comes first

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

B →

A → No location data; please input a location table

Figure 19. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface after unsuccessful completion of a LATTE analysis resulting in generation of an error message. Annotation appears in red.

In the event of unsuccessful completion of the LATTE IP epi link analysis with date data, inspect the input files for proper content and formatting and attempt to repeat the analysis. When ready to repeat the analysis, click on the [Clear inputs](#) button (B in *Figure 19*) to clear any previously uploaded input files from the webpage and then re-upload modified versions of the input files.

6. Interpreting analytic outputs — re-exposure not included

Here, results of a LATTE IP epi link analysis with date data in which the [Include re-exposure](#) box was not checked are detailed. Results of a successful analysis are downloaded as a single zipped folder. Opening the folder will unzip it and extract between six and eight individual LATTE output files (depending on whether any Gantt charts were selected to be output). All but one of these files is a Microsoft Excel file. The file names listed below include “(Prefix)” which represents the [Name prefix for output files](#) (A in *Figure 13*) entered by the user.

1. **(Prefix)LATTE_Log**: this text file provides a high-level summary of the LATTE IP epi link analysis with date data (*Figure 20*). It reports the value for the **overlap threshold** selected by the user. Persons listed in the **Table of dates in locations** input file but not in the **Table of infectious periods** input file are identified. The text “Overlaps after either IP has ended were removed from link analysis” is included to indicate that re-exposure was not included. Any Gantt chart(s) selected to be output, and the associated time interval(s), are listed. If any issues with data quality or completeness were encountered during the analysis, associated changes made by LATTE are detailed. If the analysis stopped unexpectedly due to an error, information on the associated issue(s) may be detailed.

```
LATTE analysis with date data
The following people are in the table of dates in locations but not in the table of infectious
periods so will have no IP in analysis: Contact 1, Contact 2, Contact 3, Contact 4, Contact 5,
Contact 6, Contact 7
Identifying all overlaps in time and location with people that have an IP.
Generating IP epi links with cutoff of 2 days overlapping each other and an IP. Overlaps after
either IP has ended were removed from link analysis.
Generating location Gantt chart for these time intervals: day
Generating IP Gantt chart for these time intervals: week
```

Figure 20. Screenshot of the [\(Prefix\)LATTE_Log](#) output file generated by a LATTE IP epi link analysis with date data.

2. **(Prefix)LATTE_Input_Dates**: this file consists of a single worksheet named **Location Data** that contains a summary of the data on dates of stays in locations uploaded in the **Table of dates in locations** input file (*Figure 21*).

	A	B	C	D	E
1	ID	Location	Location start	Location end	Confidence
2	Case 1	Homeless shelter A	09/01/2018	09/30/2018	certain
3	Case 2	Homeless shelter A	11/01/2018	11/05/2018	uncertain
4	Case 2	Homeless shelter A	11/06/2018	11/16/2018	certain
5	Case 3	Homeless shelter A	09/28/2018	09/28/2018	uncertain
6	Case 3	Homeless shelter A	09/29/2018	10/04/2018	certain
7	Case 3	Homeless shelter A	10/20/2018	10/20/2018	uncertain
8	Case 3	Homeless shelter A	11/03/2018	11/03/2018	uncertain
9	Case 3	Homeless shelter A	11/09/2018	11/09/2018	uncertain
10	Case 3	Homeless shelter A	11/11/2018	11/12/2018	uncertain
11	Case 4	Homeless shelter A	09/22/2018	09/23/2018	uncertain
12	Case 4	Homeless shelter A	09/24/2018	09/24/2018	certain
13	Case 4	Homeless shelter A	09/25/2018	09/30/2018	uncertain
14	Case 4	Homeless shelter A	11/02/2018	11/02/2018	uncertain
15	Case 4	Homeless shelter A	11/03/2018	11/03/2018	certain
16	Case 4	Homeless shelter A	11/04/2018	11/05/2018	uncertain
17	Contact 1	Homeless shelter A	10/03/2018	11/03/2018	certain
18	Contact 2	Homeless shelter A	09/20/2018	09/20/2018	certain
19	Contact 2	Homeless shelter A	09/24/2018	10/04/2018	certain
20	Contact 3	Homeless shelter A	09/02/2018	09/10/2018	certain
21	Contact 3	Homeless shelter A	10/05/2018	10/05/2018	certain
22	Contact 3	Homeless shelter A	10/11/2018	10/11/2018	certain
23	Contact 4	Homeless shelter A	09/26/2018	09/26/2018	uncertain
24	Contact 4	Homeless shelter A	09/29/2018	09/29/2018	uncertain
25	Contact 4	Homeless shelter A	10/04/2018	10/04/2018	uncertain
26	Contact 4	Homeless shelter A	10/10/2018	10/10/2018	uncertain
27	Contact 4	Homeless shelter A	10/15/2018	10/15/2018	uncertain
28	Contact 4	Homeless shelter A	10/18/2018	10/18/2018	uncertain
29	Contact 5	Homeless shelter A	10/23/2018	11/04/2018	uncertain
30	Contact 6	Homeless shelter A	09/30/2018	10/03/2018	certain
31	Contact 7	Homeless shelter A	09/13/2018	09/15/2018	certain
32	Contact 7	Homeless shelter A	09/30/2018	09/30/2018	uncertain
33	Contact 7	Homeless shelter A	10/04/2018	10/04/2018	uncertain
34					
35					

< >
Location Data
+

Figure 21. Screenshot of the **Location Data** worksheet within the **(Prefix)LATTE_Input_Dates** output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_Input_Dates](#) output file. Values for variables designated with an “*” are imported directly from the [Table of dates in locations](#) input file by LATTE.

- **ID:** unique person (case or contact) identifier.*
 - **Location:** location associated with the specified **ID**, **Location start**, and **Location end**.*
 - **Location start:** start date of the period of time that the person corresponding to the specified **ID** was associated with the specified **Location**. This value will be imported directly from the [Table of dates in locations](#) input file unless that input file contains multiple associations between a person and a location that overlap in time. For example, if the [Table of dates in locations](#) input file contains a record of Person A at Location A from 01/01/2020 to 01/10/2020 and another record of Person A at Location A from 01/05/2020 to 01/15/2020, LATTE will combine these into a single record in the [\(Prefix\)LATTE_Input_Dates](#) output file with **Location start** and **Location end** values of 01/01/2020 and 01/15/2020, respectively.
 - **Location end:** end date of the period of time that the person corresponding to the specified **ID** was associated with the specified **Location**. This value will be imported directly from the [Table of dates in locations](#) input file unless that input file contains multiple associations between a person and a location that overlap in time. For example, if the [Table of dates in locations](#) input file contains a record of Person A at Location A from 01/01/2020 to 01/10/2020 and another record of Person A at Location A from 01/05/2020 to 01/15/2020, LATTE will combine these into a single record in the [\(Prefix\)LATTE_Input_Dates](#) output file with **Location start** and **Location end** values of 01/01/2020 and 01/15/2020, respectively.
 - **Confidence:** confidence the user has in values for **Location start** and **Location end**.*
3. [\(Prefix\)LATTE_Input_IP](#): this file consists of a single worksheet named **IP Data** that contains a summary of the estimated infectious period start and end date data uploaded in the [Table of infectious periods](#) input file (*Figure 22*).

	A	B	C
1	ID	Infectious period start	Infectious period end
2	Case 1	09/15/2018	02/23/2019
3	Case 2	10/16/2018	04/11/2019
4	Case 3	06/03/2015	03/12/2016
5	Case 4	04/24/2016	01/27/2017
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Figure 22. Screenshot of the **IP Data** worksheet within the **(Prefix)LATTE_Input_IP** output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_Input_IP](#) output file. Values for variables designated with an “*” are imported directly from the [Table of infectious periods](#) input file by LATTE.

- **ID:** unique person (here, case) identifier.*
 - **Infectious period start:** estimated start date of the infectious period of the person corresponding to the specified **ID**.*
 - **Infectious period end:** estimated end date of the infectious period of the person corresponding to the specified **ID**.*
4. **(Prefix)LATTE_All_Overlaps:** this file consists of a single worksheet named [All Overlaps](#) that contains a summary of all individual overlaps between pairs of persons in a location, with start and end dates, and whether they occurred during an infectious period of one or both persons (*Figure 23*).

	A	B	C	D	E	F	G	H	I
1	ID1	ID2	Location	Confidence	Number of days of overlap	Overlap start date	Overlap end date	Number of days of overlap in ID1 IP	Number of days of overlap in ID2 IP
2	Case 1	Case 3	Homeless shelter A	uncertain	1	09/28/2018	09/28/2018		1 after IP end
3	Case 1	Case 3	Homeless shelter A	certain	2	09/29/2018	09/30/2018		2 after IP end
4	Case 1	Case 4	Homeless shelter A	uncertain	2	09/22/2018	09/23/2018		2 after IP end
5	Case 1	Case 4	Homeless shelter A	certain	1	09/24/2018	09/24/2018		1 after IP end
6	Case 1	Case 4	Homeless shelter A	uncertain	6	09/25/2018	09/30/2018		6 after IP end
7	Case 1	Contact 2	Homeless shelter A	certain	1	09/20/2018	09/20/2018		1 no IP available
8	Case 1	Contact 2	Homeless shelter A	certain	7	09/24/2018	09/30/2018		7 no IP available
9	Case 1	Contact 3	Homeless shelter A	certain	3	09/02/2018	09/10/2018		0 no IP available
10	Case 1	Contact 4	Homeless shelter A	uncertain	1	09/26/2018	09/26/2018		1 no IP available
11	Case 1	Contact 4	Homeless shelter A	uncertain	1	09/29/2018	09/29/2018		1 no IP available
12	Case 1	Contact 6	Homeless shelter A	certain	1	09/30/2018	09/30/2018		1 no IP available
13	Case 1	Contact 7	Homeless shelter A	certain	3	09/13/2018	09/15/2018		1 no IP available
14	Case 1	Contact 7	Homeless shelter A	uncertain	1	09/30/2018	09/30/2018		1 no IP available
15	Case 2	Case 3	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018		1 after IP end
16	Case 2	Case 3	Homeless shelter A	uncertain	1	11/09/2018	11/09/2018		1 after IP end
17	Case 2	Case 3	Homeless shelter A	uncertain	2	11/11/2018	11/12/2018		2 after IP end
18	Case 2	Case 4	Homeless shelter A	uncertain	1	11/02/2018	11/02/2018		1 after IP end
19	Case 2	Case 4	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018		1 after IP end
20	Case 2	Case 4	Homeless shelter A	uncertain	2	11/04/2018	11/05/2018		2 after IP end
21	Case 2	Contact 1	Homeless shelter A	uncertain	3	11/01/2018	11/03/2018		3 no IP available
22	Case 2	Contact 5	Homeless shelter A	uncertain	4	11/01/2018	11/04/2018		4 no IP available
23	Case 3	Case 4	Homeless shelter A	uncertain	1	09/28/2018	09/28/2018	after IP end	after IP end
24	Case 3	Case 4	Homeless shelter A	uncertain	2	09/29/2018	09/30/2018	after IP end	after IP end
25	Case 3	Case 4	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	after IP end	after IP end
26	Case 3	Contact 1	Homeless shelter A	certain	2	10/03/2018	10/04/2018	after IP end	no IP available
27	Case 3	Contact 1	Homeless shelter A	uncertain	1	10/20/2018	10/20/2018	after IP end	no IP available
28	Case 3	Contact 1	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	after IP end	no IP available
29	Case 3	Contact 2	Homeless shelter A	uncertain	1	09/28/2018	09/28/2018	after IP end	no IP available
30	Case 3	Contact 2	Homeless shelter A	certain	6	09/29/2018	10/04/2018	after IP end	no IP available
31	Case 3	Contact 4	Homeless shelter A	uncertain	1	09/23/2018	09/29/2018	after IP end	no IP available
32	Case 3	Contact 4	Homeless shelter A	uncertain	1	10/04/2018	10/04/2018	after IP end	no IP available
33	Case 3	Contact 5	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	after IP end	no IP available
34	Case 3	Contact 6	Homeless shelter A	certain	4	09/30/2018	10/03/2018	after IP end	no IP available
35	Case 3	Contact 7	Homeless shelter A	uncertain	1	09/30/2018	09/30/2018	after IP end	no IP available
36	Case 3	Contact 7	Homeless shelter A	uncertain	1	10/04/2018	10/04/2018	after IP end	no IP available
37	Case 4	Contact 1	Homeless shelter A	uncertain	1	11/02/2018	11/02/2018	after IP end	no IP available
38	Case 4	Contact 1	Homeless shelter A	certain	1	11/03/2018	11/03/2018	after IP end	no IP available
39	Case 4	Contact 2	Homeless shelter A	certain	1	09/24/2018	09/24/2018	after IP end	no IP available
40	Case 4	Contact 2	Homeless shelter A	uncertain	6	09/25/2018	09/30/2018	after IP end	no IP available
41	Case 4	Contact 4	Homeless shelter A	uncertain	1	09/26/2018	09/26/2018	after IP end	no IP available
42	Case 4	Contact 4	Homeless shelter A	uncertain	1	09/29/2018	09/29/2018	after IP end	no IP available
43	Case 4	Contact 5	Homeless shelter A	uncertain	1	11/02/2018	11/02/2018	after IP end	no IP available
44	Case 4	Contact 5	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	after IP end	no IP available
45	Case 4	Contact 5	Homeless shelter A	uncertain	1	11/04/2018	11/04/2018	after IP end	no IP available
46	Case 4	Contact 6	Homeless shelter A	uncertain	1	09/30/2018	09/30/2018	after IP end	no IP available
47	Case 4	Contact 7	Homeless shelter A	uncertain	1	09/30/2018	09/30/2018	after IP end	no IP available
48									
49									

[All Overlaps](#) 

Figure 23. Screenshot of the All Overlaps worksheet within the (Prefix)LATTE_All_Overlaps output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the (Prefix)LATTE_All_Overlaps output file.

- **ID1:** unique person (case or contact) identifier for one person in an epi linked pair of persons.

- **ID2:** unique person (case or contact) identifier for the other person in an epi linked pair of persons.
 - **Location:** location where the persons corresponding to the specified **ID1** and **ID2** overlapped.
 - **Confidence:** confidence the user has in values for **Location start** or **Location end** or both for both persons (**ID1** and **ID2**) at the specified **Location**. If the confidence for both **Location start** and **Location end** for both persons was “Certain” then the value will be “certain.” If either the **Location start** or **Location end** for either person was “Uncertain” then the value will be “uncertain.”
 - **Number of days of overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** continuously overlapped at the specified **Location** during the period defined by the **Overlap start date** and **Overlap end date**.
 - **Overlap start date:** first day that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location**.
 - **Overlap end date:** last day that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location**.
 - **Number of days of overlap in ID1 IP:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** during the infectious period of the person corresponding to the specified **ID1**. If infectious period dates were not included for the person corresponding to the specified **ID1** (e.g., dates were not known, or the first person is a contact rather than a case), the value for this variable will be “no IP available.”
 - **Number of days of overlap in ID2 IP:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** during the infectious period of the person corresponding to the specified **ID2**. If infectious period dates were not included for the person corresponding to the specified **ID2** (e.g., dates were not known, or the second person is a contact rather than a case), the value for this variable will be “no IP available.”
5. **(Prefix)LATTE_Summary_By_Person:** this file consists of a single worksheet named **Summary By Person** that contains a summary for each person of the total number of days of overlap with other persons included in the analysis (*Figure 24*).

	A	B	C	D	E	F	G	H
1	ID	Locations	Total number of days of certain overlap with another person	Total number of days of any overlap with another person during an IP	Total number of days of certain overlap with another person during an IP	Last date of certain overlap with another person during their IP	Last date of overlap with another person during their IP	
2	Case 1	Homeless shelter A	24	36	0	0		
3	Case 2	Homeless shelter A	0	15	0	0		
4	Case 3	Homeless shelter A	14	31	2	7 09/30/2018	11/12/2018	
5	Case 4	Homeless shelter A	3	33	1	13 09/24/2018	11/05/2018	
6	Contact 1	Homeless shelter A	3	9	0	3	11/03/2018	
7	Contact 2	Homeless shelter A	15	22	8	8 09/30/2018	09/30/2018	
8	Contact 3	Homeless shelter A	9	9	0	0		
9	Contact 4	Homeless shelter A	0	6	0	2	09/29/2018	
10	Contact 5	Homeless shelter A	0	8	0	4	11/04/2018	
11	Contact 6	Homeless shelter A	5	6	1	1 09/30/2018	09/30/2018	
12	Contact 7	Homeless shelter A	3	7	1	2 09/15/2018	09/30/2018	
13								
14								
15								
16								
17								
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21								
22								
23								
24								
25								
26								
27								
28								

[Summary By Person](#)

Figure 24. Screenshot of the [Summary By Person](#) worksheet within the [\(Prefix\)LATTE_Summary_By_Person](#) output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_Summary_By_Person](#) output file.

- **ID:** unique person (case or contact) identifier.
- **Locations:** comma-separated list of all locations where the person corresponding to the specified **ID** had at least one day of overlap with another person (case or contact) included in the analysis.
- **Total number of days of certain overlap with another person:** the total number of days that the person corresponding to the specified **ID** overlapped with other persons included in the analysis with

certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were “Certain”).

- **Total number of days of any overlap with another person:** the total number of days that the person corresponding to the specified **ID** overlapped with other persons included in the analysis irrespective of certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were either “Certain” or “Uncertain”).
 - **Total number of days of certain overlap with another person during an IP:** the total number of days that the person corresponding to the specified **ID** overlapped during an infectious period with other persons included in the analysis with certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were “Certain”).
 - **Total number of days of any overlap with another person during an IP:** the total number of days that the person corresponding to the specified **ID** overlapped during an infectious period with other persons included in the analysis irrespective of certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were either “Certain” or “Uncertain”).
 - **Last date of certain overlap with another person during their IP:** the last date that the person corresponding to the specified **ID** overlapped during an infectious period with other persons included in the analysis with certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were “Certain”).
 - **Last date of overlap with another person during their IP:** the last date that the person corresponding to the specified **ID** overlapped during an infectious period with other persons included in the analysis irrespective of certainty (i.e., values of **Confidence** for **Location start** and **Location end** for both persons were either “Certain” or “Uncertain”).
6. **(Prefix)LATTE_IPEpi_Links_2D:** this file consists of a single worksheet named **IPEpi 2D** that contains a summary of the total duration of overlap between pairs of persons in one or more locations where they overlapped and the strength of associated IP epi links (*Figure 25*).

	A	B	C	D	E	F
1	ID1	ID2	Strength	Location	Total number of days of certain overlap	Total number of days of any overlap
2	Case 1	Contact 2	definite	Homeless shelter A	8	8
3	Case 1	Contact 4	probable	Homeless shelter A	0	2
4	Case 1	Contact 7	probable	Homeless shelter A	1	2
5	Case 2	Contact 1	probable	Homeless shelter A	0	3
6	Case 2	Contact 5	probable	Homeless shelter A	0	4
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						

Figure 25. Screenshot of the IPEpi 2D worksheet within the [\(Prefix\)LATTE_IPEpi_Links_2D](#) output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_IPEpi_Links_2D](#) output file.

- **ID1:** unique person (case or contact) identifier for one person in an epi linked pair of persons.
- **ID2:** unique person (case or contact) identifier for the other person in an epi linked pair of persons.
- **Strength:** the strength of the IP epi link between persons corresponding to the specified **ID1** and **ID2** who overlapped at the specified **Location**. As illustrated in [Figure 1](#) and [Figure 2](#), if the confidence for both **Location start** and **Location end** for both persons was “Certain” and the combined duration of all “Certain” overlaps between the two persons during the infectious period of one of the persons was equal to or exceeded the value selected for the **overlap threshold** set by the user, **Strength** will be

“definite.” If the confidence for either **Location start** or **Location end** for either person was “Uncertain” and the combined duration of all overlaps was equal to or exceeded the value selected for the **overlap threshold** by the user, **Strength** will be “probable.” Finally, if the duration of overlap during the infectious period of one of the persons was less than the value selected for the **overlap threshold** by the user, a link will not be made.

- **Location:** comma-separated list of all locations where the persons corresponding to the specified **ID1** and **ID2** overlapped.
- **Total number of days of certain overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** with certainty. If the confidence for both **Location start** and **Location end** for both persons was “Certain” then the value will be “certain.” If either the **Location start** or **Location end** for either person was “Uncertain” then the value will be “uncertain.”
- **Total number of days of any overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** irrespective of certainty.

Note that the name of both the file and the worksheet contain the value selected for the **overlap threshold** set by the user (here, two days, or “2D”). If the value selected for the **overlap threshold** set by the user had been “5,” then the name of this output file would have been **(Prefix)LATTE_IPEpi_Links_5D** and the name of the worksheet would have been **IPEpi 5D**.

7. **(Prefix)LATTE_Gantt_Chart_By_Location:** this file consists of one or more worksheets each containing a location Gantt chart with a different time interval. The file will only be generated if one or more location Gantt charts was selected for output. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided [below](#).
8. **(Prefix)LATTE_Gantt_Chart_IP:** this file consists of one or more worksheets each containing an IP Gantt chart with a different time interval. The file will only be generated if one or more IP Gantt charts was selected for output. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided [below](#).

7. Interpreting analytic outputs — re-exposure included

Here, results of a LATTE IP epi link analysis with date data in which the **Include re-exposure** box was checked are detailed. Most of the output files, file and worksheet names, and variable names are the same as those described [above](#) for an successful LATTE IP epi link analysis with date data in which the **Include**

re-exposure box was not checked. When differences in results exist (i.e., re-exposure included versus excluded), screenshots of output files are provided and differences in results are detailed.

1. **(Prefix)LATTE_Log:** this text file provides a high-level summary of the LATTE IP epi link analysis (*Figure 26*). In addition to the information described *above*, the text “Overlaps after either IP has ended were kept in link analysis” to indicate that re-exposure was included.

```
LATTE analysis with date data
The following people are in the table of dates in locations but not in the table of infectious
periods so will have no IP in analysis: Contact 1, Contact 2, Contact 3, Contact 4, Contact 5,
Contact 6, Contact 7
Identifying all overlaps in time and location with people that have an IP.
Generating IP epi links with cutoff of 2 days overlapping each other and an IP. Overlaps after
either IP has ended were kept in link analysis.
Generating location Gantt chart for these time intervals: day
Generating IP Gantt chart for these time intervals: week
```

Figure 26. Screenshot of the (Prefix)LATTE_Log output file generated by a LATTE IP epi link analysis with date data.

2. **(Prefix)LATTE_Input_Dates:** this file consists of a single worksheet named **Location Data** that contains a summary of the data on dates of stays in locations uploaded in the **Table of dates in locations** input file. Relative to the file described *above* (generated when re-exposure was not included), the contents of this file are unchanged (*Figure 21*).
3. **(Prefix)LATTE_Input_IP:** this file consists of a single worksheet named **IP Data** that contains a summary of the estimated infectious period start and end date data uploaded in the **Table of infectious periods** input file. Relative to the file described *above* (generated when re-exposure was not included), the contents of this file are unchanged (*Figure 22*).
4. **(Prefix)LATTE_All_Overlaps:** this file consists of a single worksheet named **All Overlaps** that contains a summary of all individual overlaps between pairs of persons in a location, with start and end dates, and whether they occurred during an infectious period of one or both of the persons. Relative to the file described *above* (generated when re-exposure was not included), the column headers of this file are unchanged (*Figure 23*), but overlaps that occur after the end of the earlier IP but during the later IP will be included.
5. **(Prefix)LATTE_Summary_By_Person:** this file consists of a single worksheet named **Summary By Person** that contains a summary for each person of the total number of days of overlap with other persons included in the analysis. Relative to the file described *above* (generated when re-exposure

was not included), the column headers of this file are unchanged (*Figure 24*), but overlaps that occur after the end of the earlier IP but during the later IP will be included.

6. (Prefix)LATTE_IPEpi_Links_2D_KeepOLAfterIPEnd: this file consists of a single worksheet named IPEpi 2D KeepOLAfterIPend that contains a summary of the total duration of overlap between pairs of persons in one or more locations where they overlapped and the strength of associated IP epi links (*Figure 27*).

	A	B	C	D	E	F
1	ID1	ID2	Strength	Location	Total number of days of certain overlap	Total number of days of any overlap
2	Case 1	Case 3	definite	Homeless shelter A	2	3
3	Case 1	Case 4	probable	Homeless shelter A	1	9
4	Case 1	Contact 2	definite	Homeless shelter A	8	8
5	Case 1	Contact 4	probable	Homeless shelter A	0	2
6	Case 1	Contact 7	probable	Homeless shelter A	1	2
7	Case 2	Case 3	probable	Homeless shelter A	0	4
8	Case 2	Case 4	probable	Homeless shelter A	0	4
9	Case 2	Contact 1	probable	Homeless shelter A	0	3
10	Case 2	Contact 5	probable	Homeless shelter A	0	4
11						
12						
13						
14						
15						
16						
17						
18						
19						

Figure 27. Screenshot of the IPEpi 2D KeepOLAfterIPend worksheet within the (Prefix)LATTE_IPEpi_Links_2D_KeepOLAfterIPEnd output file generated by a LATTE IP epi link analysis with date data.

Data for the following variables are included in the
[\(Prefix\)LATTE_IPEpi_Links_2D_KeepOLAfterIPEnd](#) output file.

- **ID1:** unique person (case or contact) identifier for one person in an epi linked pair of persons.
- **ID2:** unique person (case or contact) identifier for the other person in an epi linked pair of persons.
- **Strength:** the strength of the IP epi link between persons corresponding to the specified **ID1** and **ID2** who overlapped at the specified **Location**. As illustrated in [Figure 1](#) and [Figure 2](#), if the confidence for both **Location start** and **Location end** for both persons was “Certain” and the combined duration of all “Certain” overlaps between the two persons during the infectious period of one of the persons was equal to or exceeded the value selected for the **overlap threshold** set by the user, **Strength** will be “definite.” If the confidence for either **Location start** or **Location end** for either person was “Uncertain” and the combined duration of all overlaps between the two persons was equal to or exceeded the value selected for the **overlap threshold** set by the user, **Strength** will be “probable.” If the duration of overlap during the infectious period of one of the persons was less than the value selected for the **overlap threshold** set by the user, a link will not be made.
- **Location:** comma-separated list of all locations where the persons corresponding to the specified **ID1** and **ID2** overlapped.
- **Total number of days of certain overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** with certainty. If the confidence for both **Location start** and **Location end** for both persons was “Certain” then the value will be “certain.” If either the **Location start** or **Location end** for either person was “Uncertain” then the value will be “uncertain.”
- **Total number of days of any overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** irrespective of certainty.

Note that the name of both the file and the worksheet contain the value selected for the **overlap threshold** set by the user (here, two days, or “2D”). If the value selected for the **overlap threshold** set by the user had been “5,” then the name of this output file would have been

[\(Prefix\)LATTE_IPEpi_Links_5D_KeepOLAfterIPEnd](#) and the name of the worksheet would have been [IPEpi 5D KeepOLAfterIPend](#).

7. **(Prefix)LATTE_Gantt_Chart_By_Location:** this file consists of one or more worksheets each containing a location Gantt chart with a different time interval. The file will only be generated if one or more location Gantt charts was selected for output. Relative to the file mentioned [above](#) (generated

when re-exposure was not included), the contents of this file are unchanged. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided *below*.

8. **(Prefix)LATTE_Gantt_Chart_IP:** this file consists of one or more worksheets each containing an IP Gantt chart with a different time interval. The file will only be generated if one or more IP Gantt charts was selected for output. Relative to the file mentioned *above* (generated when re-exposure was not included), the contents of this file are unchanged. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided *below*.

LATTE epi link analysis with date data

A. *Preparing data*

1. Data overview

One type of data, uploaded to LATTE as a single input file, is required for a LATTE epi link analysis with date data.

1. **Table of dates in locations:** this input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations) and the user's confidence in this location/date information.

While not required for a LATTE epi link analysis with date data, data on estimated infectious period dates can be included as a separate, optional input file.

2. **Table of infectious periods:** this input file contains information on the estimated infectious period (IP) start and end dates for one or more cases included in an analysis.

Separate input file templates (Microsoft Excel files) are available for the [Table of dates in locations](#) and [Table of infectious periods](#) input files. These templates can be downloaded from the [DTBE TB genotyping](#) webpage, which can be accessed using this [link](#) or through a link on the LATTE online user interface (see [Figure 10](#)). Each template file contains a data worksheet (named [data](#)) into which the data to be analyzed are entered, and a metadata worksheet (named [metadata](#)) that provides information about

the names, definition, and formatting of variables included in the [data](#) worksheet. The [data](#) worksheet must be in the first position (i.e., to the left of the [metadata](#) worksheet) as this is the worksheet position from which LATTE pulls data for an analysis.

Note: all screenshots and discussion of analytic outputs presented in this user's manual are based on LATTE analyses of the input files associated with [LATTE training dataset 01](#) and [LATTE training dataset 02](#). These analyses can be replicated by downloading the [LATTE training dataset 01](#) and [LATTE training dataset 02](#) input files (see section on training datasets *below*) and using them to perform LATTE analyses as described in this user's manual. Additionally, screenshots of the LATTE online user interface presented in this user's manual were taken while running LATTE in the Google Chrome web browser. Note that LATTE seems to consistently perform with few if any issues when used in the Chrome web browser; the LATTE online user interface may appear slightly different in other browsers.

IMPORTANT: DO NOT INCLUDE PERSONALLY IDENTIFIABLE INFORMATION (PII) ABOUT CASES, CONTACTS, OR LOCATIONS

When populating the [Table of dates in locations](#) and [Table of infectious periods](#) input files, deidentified data should be used. Personally identifiable information about cases, contacts, or locations should never be uploaded to CDC servers as part of a LATTE analysis. This is because any information uploaded to a CDC server might be considered a federal record and therefore be subject to disclosure under the federal Freedom of Information Act or other laws. Do not use the real and complete names of cases or contacts as values for [ID](#) or the real and complete names of locations (e.g., schools, shelters, workplaces) as values for [Location](#), especially in geographically small areas. Further, be mindful of situations in which combinations of data can allow for personal identification. Users should endeavor to deidentify potentially identifying information whenever possible (e.g., if the location is a restaurant, consider assigning an identifier like “Restaurant A” or even “Location A” instead of using the name of the restaurant). A separate key to allow translation of generic identifiers back to actual names can be maintained by the user as a separate file that is stored locally (i.e., not on a CDC server).

2. Table of dates in locations

The [Table of dates in locations](#) input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations). A screenshot of the [Table of dates in locations](#) input file from [LATTE training dataset 01](#)

provides an example of how a populated [data](#) worksheet might appear (*Figure 6*). See the section [above](#) associated with a LATTE IP epi link analysis with date data for instructions on how to populate a [Table of dates in locations](#).

3. Table of infectious periods

The [Table of infectious periods](#) input file contains information on the estimated infectious period start dates and infectious period end dates for one or more persons (here, cases) included in an analysis. A screenshot of the [Table of infectious periods](#) input file from [LATTE training dataset 01](#) provides an example of how a populated [data](#) worksheet might appear (*Figure 7*). See the section [above](#) associated with a LATTE IP epi link analysis with date data for instructions on how to populate a [Table of infectious periods](#).

B. Performing an epi link analysis with date data

A LATTE epi link analysis with date data is performed on the [Link analysis with date data](#) tab of the LATTE online user interface (*Figure 9*). This is the first (left to right) of three tabs on the online user interface (A in *Figure 9*). Clicking on the [Help](#) (“?”) button (B in *Figure 9*) will reveal a pop up window (A in *Figure 10*) that provides links to LATTE supporting material including the LATTE R source code (hosted on the [TB molecular epidemiology GitHub](#) webpage) and a LATTE user’s manual, training presentation, input file templates (see section on preparing data [above](#)), and training datasets (see section on training datasets [below](#)) (hosted on the [DTBE TB genotyping](#) webpage). Alternatively, the [TB molecular epidemiology GitHub](#) webpage can also be accessed using this [link](#) and the [DTBE TB genotyping](#) webpage can also be accessed using this [link](#).

1. Set up inputs

Only a [Table of dates in locations](#) input file is required to perform a LATTE epi link analysis with date data. To upload a [Table of dates in locations](#) input file, click the [Browse](#) button under “Table of dates in locations (required)” on the left of the screen (A in *Figure 28*) and select the [Table of dates in locations](#) input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer in any drive or folder that can be accessed via the browser’s finder).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

A → No file selected

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

B → No file selected

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.



Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Figure 28. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing features to set up inputs. Annotation appears in red.

Once the [Table of dates in locations](#) input file has been successfully uploaded, the file name will appear in the box to the right of the associated [Browse](#) button and a hatched blue bar reading “Upload complete” will appear below the box (*Figure 29*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... No file selected

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.



Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s).
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s).
 Day
 Week
 Month

Name prefix for output files

Clear inputs

Run

Figure 29. Screenshot of the Link analysis with date data tab of the LATTE online user interface showing a successfully uploaded Table of dates in locations input file.

While a [Table of infectious periods](#) input file is not required to perform a LATTE epi link analysis with date data, it can be included as an optional input file. If included as an optional input file, a LATTE epi link analysis with date data will still identify epi links rather than IP epi links (i.e., identify all overlaps rather than the subset of overlaps that occurred during an infectious period), but some characteristics of overlaps related to infectious periods will be reported. To upload a [Table of infectious periods](#) input file, click the [Browse](#) button under “Table of dates in locations (required)” on the left of the screen (B in [Figure 28](#)) and select the [Table of infectious periods](#) input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer in any drive or folder that can be accessed via the browser’s finder).

2. Set up outputs

After uploading a [Table of dates in locations](#) input file (and optionally, a [Table of infectious periods](#) input file), set up outputs by assigning a [Name prefix for output files](#) generated by the analysis.

1. **Name prefix for output files:** The text entered here (A in *Figure 30*) will form the prefix for the name of the zipped folder that is generated by the analysis and each of the LATTE output files contained within it. Additionally, LATTE will append the text “LATTE” to the name prefix when naming the folder and files. For example, if the text “Example” is entered, the zipped folder generated by the associated LATTE analysis will be named “ExampleLATTE,” and the names of each of the output files contained within it will begin with “ExampleLATTE.” If this field is left blank, output files will not be assigned a name prefix.

The screenshot shows the LATTE online user interface for 'Link analysis with date data'. The interface is titled 'Location And Time To Epi (LATTE)' and includes tabs for 'Link analysis with date data' (selected), 'Link analysis without date data', and 'Gantt charts only'. A question mark icon is in the top right corner.

Set up inputs:

- Warning: do not upload personally identifiable information (PII)
- Table of dates in locations (required): LATTE_training_dataset_01_T (selected)
- Table of infectious periods (IP) (required for IP epi link and IP Gantt chart): No file selected

Set up link definitions:

- Type of link: Epi link (all overlaps) (selected)
- Overlap threshold: A slider set to 2 days.

Set up Gantt chart outputs:

- Generate location Gantt chart(s):
 - Select time interval(s): Day (checked)
 - Week
 - Month
- Generate IP Gantt chart(s):
 - Select time interval(s): Week (checked)
 - Day
 - Month

Set up outputs:

Name prefix for output files: A → Example

Buttons: Clear inputs, Run

Figure 30. Annotated screenshot of the Link analysis with date data tab of the LATTE online user interface showing features to set up outputs. Annotation appears in red.

3. Set up link definitions

After setting up inputs and outputs, set up link definitions by selecting the appropriate **Type of link** and desired **overlap threshold** for the LATTE epi link analysis with date data.

1. **Type of link:** To perform a LATTE epi link analysis with date data, select **epi link** (A in *Figure 31*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... No file selected

A → Set up link definitions

Type of link

- Epi link (all overlaps)
- IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.

B → Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Example

Clear inputs

Run

Figure 31. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing features to set up link definitions. Annotation appears in red.

2. **Overlap threshold:** for a LATTE epi link analysis with date data, this slider (B in *Figure 31*) is used to set the number of days persons included in the analysis must overlap with each other in a location to form a definite, probable, or possible epi link. The default value is two days but can be adjusted by the user to vary between zero and 30 days. In practice, an [overlap threshold](#) value of two means that if two persons overlap for two or more days in a location, LATTE will consider it possible for those persons to have a definite or probable epi link associated with that location. In contrast, if the overlap is for fewer than two days, LATTE will only consider those persons to have a possible epi link associated with that location.

4. Set up Gantt chart outputs

After setting up link definitions, set up Gantt chart outputs using check boxes to select the desired type(s) of Gantt chart(s), if any, to be output by the analysis and the time interval(s) (i.e., temporal resolution) for each type of chart. Note that including Gantt chart outputs as part of a LATTE analysis can significantly increase the amount of time required to complete the analysis when the volume of included date data is large.

1. Location Gantt charts: location Gantt charts facilitate visualization of dates of stays in locations (and estimated dates of infectious periods if a [Table of infectious periods](#) input file was uploaded). Check the [Generate location Gantt chart\(s\)](#) box (A in *Figure 32*) if one or more location Gantt charts are desired. When this box is checked, the time interval(s) (i.e., temporal resolution) for the location Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s).
2. IP Gantt charts: IP Gantt charts facilitate visualization of estimated dates of infectious periods. If a [Table of infectious periods](#) was uploaded and one or more IP Gantt charts are desired, check the [Generate IP Gantt chart\(s\)](#) box (B in *Figure 32*). When this box is checked, the time interval(s) (i.e., temporal resolution) for the IP Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s). The analysis will not run if the [Generate IP Gantt chart\(s\)](#) box is checked but a [Table of infectious periods](#) has not been uploaded.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

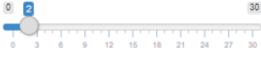
Browse... No file selected

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.


A → Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

B → Set up Gantt chart outputs

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Example

Clear inputs

Run

Figure 32. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing features to set up Gantt chart outputs. Annotation appears in red.

5. Initiating an analysis

Once the [Table of dates in locations](#) input file (and optionally, a [Table of infectious periods](#) input file) has been successfully uploaded and analysis parameters have been set, click on the [Run](#) button (A in [Figure 33](#)) to initiate the LATTE epi link analysis with date data. If the analysis is proceeding successfully, a progress bar will appear in the bottom right corner of the screen above text that reads “Running LATTE” (B in [Figure 33](#)).

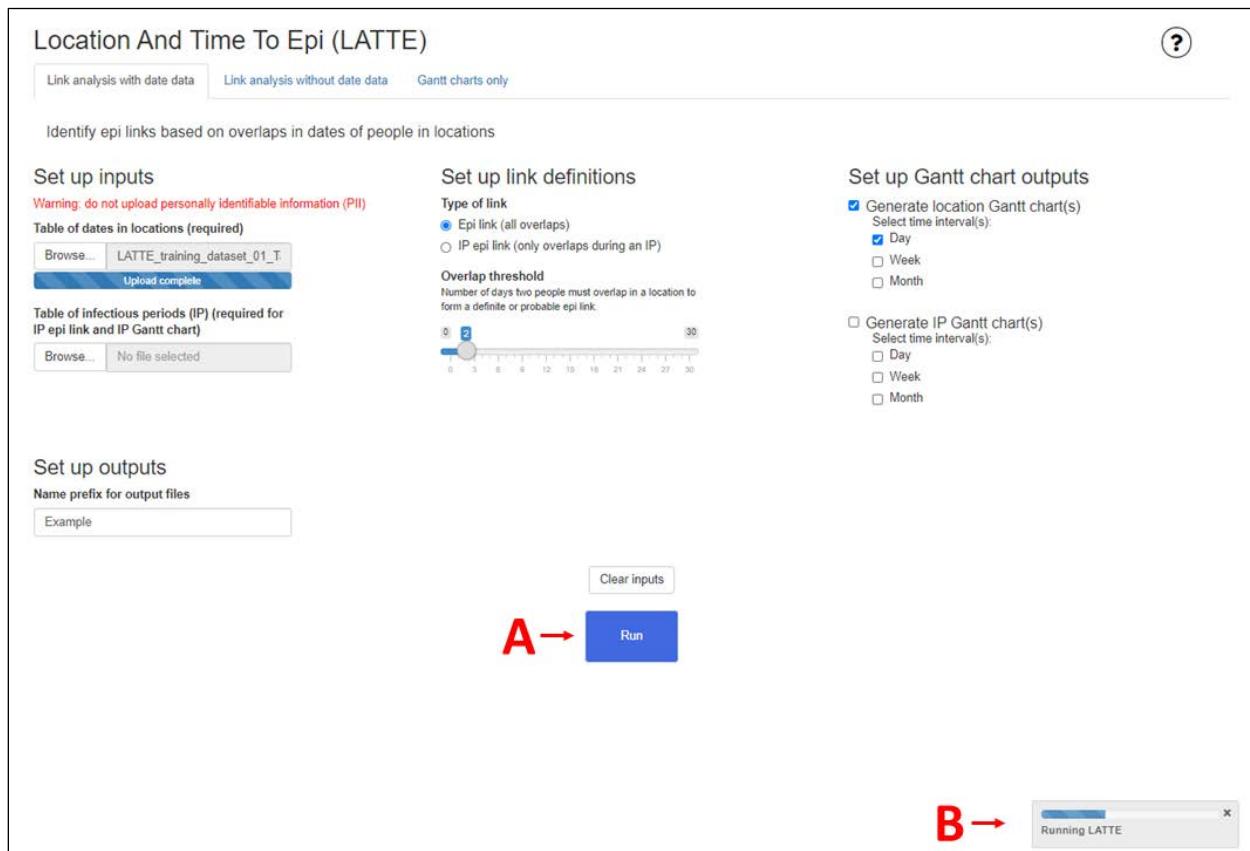


Figure 33. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface showing an analysis in progress and proceeding successfully. Annotation appears in red.

When the analysis is complete, text that reads “Analysis complete” and a [Download Results](#) button will appear beneath the [Run](#) button (A in [Figure 34](#)).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... No file selected

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Example

[Clear inputs](#)

[Run](#)

Analysis complete

A → [Download Results](#)

Figure 34. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface after successful completion of a LATTE analysis. Annotation appears in red.

After clicking on the [Download Results](#) button, an icon of a zipped download file will appear in the bottom left hand corner of the screen if you are using the Google Chrome browser (A in [Figure 35](#)). Other browsers might have a different way of indicating that a file has been downloaded. Click on this icon to choose the location where the zipped folder containing the results of the LATTE epi link analysis with date data should be saved. Note that after clicking on the [Download Results](#) button, the specific steps to follow to save results of the analysis, and the appearance of the screen, may vary slightly depending on the browser and browser settings being used.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... LATTE_training_dataset_01.T Upload complete

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... No file selected

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.



Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Example

Clear inputs

Run

Download complete

Download Results

ExampleLATTE.zip ← A Show all X

Figure 35. Annotated screenshot of the Link analysis with date data tab of the LATTE online user interface after successful completion of a LATTE analysis and clicking on the Download Results button. Annotation appears in red.

If the LATTE epi link analysis with date data cannot be successfully completed for some reason, an error message may appear. For example, the message “No location data. Please input a location table” will appear below the Run button (A in *Figure 36*) if a Table of dates in locations input file was not successfully uploaded.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only [?](#)

Identify epi links based on overlaps in dates of people in locations

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required)

Browse... No file selected

Table of infectious periods (IP) (required for IP epi link and IP Gantt chart)

Browse... LATTE_training_dataset_01_T.
Upload complete

Set up link definitions

Type of link

Epi link (all overlaps)
 IP epi link (only overlaps during an IP)

Overlap threshold

Number of days two people must overlap in a location to form a definite or probable epi link.

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Example

B → Clear inputs
A → No location data; please input a location table
Run

Figure 36. Annotated screenshot of the [Link analysis with date data](#) tab of the LATTE online user interface after unsuccessful completion of a LATTE analysis resulting in generation of an error message. Annotation appears in red.

In the event of unsuccessful completion of the LATTE epi link analysis with date data, inspect the input file(s) for proper content and formatting and attempt to repeat the analysis. When ready to repeat the analysis, click on the [Clear inputs](#) button (B in *Figure 36*) to clear any previously uploaded input file(s) from the webpage and then re-upload modified versions of the input file(s).

6. Interpreting analytic outputs

Results of a successful LATTE epi link analysis with date data are downloaded as a single zipped folder. Opening the folder will unzip it and extract between five and eight individual LATTE output files (depending on whether a [Table of infectious periods](#) was uploaded as an optional input file and whether any Gantt charts were selected to be output). All but one of these files is a Microsoft Excel file. The file names listed below include “(Prefix)” which represents the [Name prefix for output files](#) (A in *Figure 30*) entered by the user.

1. **(Prefix)LATTE_Log**: this text file provides a high-level summary of the LATTE epi link analysis with date data (*Figure 37*). It reports the value for the **overlap threshold** selected by the user. Any Gantt chart(s) selected to be output, and the associated time interval(s), are listed. If any issues with data quality or completeness were encountered during the analysis, associated changes made by LATTE are detailed. If the analysis stopped unexpectedly due to an error, information on the associated issue(s) may be detailed.

```
LATTE analysis with date data
Identifying all overlaps in time and location between all people.
Generating epi links with cutoff of 2 days for a definite or probable epi link
Generating location Gantt chart for these time intervals: day
No IP Gantt chart generated
```

Figure 37. Screenshot of the **(Prefix)LATTE_Log** output file generated by a LATTE epi link analysis with date data.

2. **(Prefix)LATTE_Input_Dates**: this file consists of a single worksheet named **Location Data** that contains a summary of the data on dates of stays in locations uploaded in the **Table of dates in locations** input file (*Figure 21*). See *above* for a description of the variables included in the **(Prefix)LATTE_Input_Dates** output file.
3. **(Prefix)LATTE_All_Overlaps**: this file consists of a single worksheet named **All Overlaps** that contains a summary of all individual overlaps between pairs of persons (cases or contacts) in a location, with start and end dates, and whether they occurred during an infectious period of one or both persons (*Figure 38*). Each row in the worksheet corresponds to a unique overlap (i.e., unique

combination of persons, location, and dates of overlap).

	A	B	C	D	E	F	G	H	I
1	ID1	ID2	Location	Confidence	Number of days of overlap	Overlap start date	Overlap end date	Number of days of overlap in ID1 IP	Number of days of overlap in ID2 IP
2	Case 1	Case 3	Homeless shelter A	uncertain	1	09/28/2018	09/28/2018	no IP available	no IP available
3	Case 1	Case 3	Homeless shelter A	certain	2	09/29/2018	09/30/2018	no IP available	no IP available
4	Case 1	Case 4	Homeless shelter A	uncertain	2	09/22/2018	09/23/2018	no IP available	no IP available
5	Case 1	Case 4	Homeless shelter A	certain	1	09/24/2018	09/24/2018	no IP available	no IP available
6	Case 1	Case 4	Homeless shelter A	uncertain	6	09/25/2018	09/30/2018	no IP available	no IP available
7	Case 1	Contact 2	Homeless shelter A	certain	1	09/20/2018	09/20/2018	no IP available	no IP available
8	Case 1	Contact 2	Homeless shelter A	certain	7	09/24/2018	09/30/2018	no IP available	no IP available
9	Case 1	Contact 3	Homeless shelter A	certain	9	09/02/2018	09/10/2018	no IP available	no IP available
10	Case 1	Contact 4	Homeless shelter A	uncertain	1	09/26/2018	09/26/2018	no IP available	no IP available
11	Case 1	Contact 4	Homeless shelter A	uncertain	1	09/29/2018	09/29/2018	no IP available	no IP available
12	Case 1	Contact 6	Homeless shelter A	certain	1	09/30/2018	09/30/2018	no IP available	no IP available
13	Case 1	Contact 7	Homeless shelter A	certain	3	09/13/2018	09/15/2018	no IP available	no IP available
14	Case 1	Contact 7	Homeless shelter A	uncertain	1	09/30/2018	09/30/2018	no IP available	no IP available
15	Case 2	Case 3	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	no IP available	no IP available
16	Case 2	Case 3	Homeless shelter A	uncertain	1	11/09/2018	11/09/2018	no IP available	no IP available
17	Case 2	Case 3	Homeless shelter A	uncertain	2	11/11/2018	11/12/2018	no IP available	no IP available
18	Case 2	Case 4	Homeless shelter A	uncertain	1	11/02/2018	11/02/2018	no IP available	no IP available
19	Case 2	Case 4	Homeless shelter A	uncertain	1	11/03/2018	11/03/2018	no IP available	no IP available
20	Case 2	Case 4	Homeless shelter A	uncertain	2	11/04/2018	11/05/2018	no IP available	no IP available
21	Case 2	Contact 1	Homeless shelter A	uncertain	3	11/01/2018	11/03/2018	no IP available	no IP available
22	Case 2	Contact 5	Homeless shelter A	uncertain	4	11/01/2018	11/04/2018	no IP available	no IP available
23	Case 3	Case 4	Homeless shelter A	uncertain	1	09/28/2018	09/28/2018	no IP available	no IP available
24	Case 3	Case 4	Homeless shelter A	uncertain	2	09/29/2018	09/30/2018	no IP available	no IP available

Figure 38. Screenshot of the upper portion of the [All Overlaps](#) worksheet within the [\(Prefix\)LATTE_All_Overlaps](#) output file generated by a LATTE epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_All_Overlaps](#) output file.

- **ID1:** unique person (case or contact) identifier for one person in an epi linked pair of persons.
- **ID2:** unique person (case or contact) identifier for the other person in an epi linked pair of persons.
- **Location:** location associated with the specified **ID1**, **ID2**, **Overlap start date**, and **Overlap end date**.
- **Confidence:** confidence the user has in values for **Location start** and **Location end** or both for both persons (**ID1** and **ID2**) at the specified **Location**. If the confidence for both **Location start** and **Location end** for both persons was “Certain” then the value will be “certain.” If either the **Location start** or **Location end** for either person was “Uncertain” then the value will be “uncertain.”
- **Number of days of overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** continuously overlapped at the specified **Location** during the period defined by the **Overlap start date** and **Overlap end date**.
- **Overlap start date:** first day that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location**.
- **Overlap end date:** last day that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location**.

- Number of days of overlap in ID1 IP: total number of days that the persons corresponding to the specified ID1 and ID2 overlapped at the specified Location during the infectious period of the person corresponding to the specified ID1. Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be “no IP available.”
 - Number of days of overlap in ID2 IP: total number of days that the persons corresponding to the specified ID1 and ID2 overlapped at the specified Location during the infectious period of the person corresponding to the specified ID2. Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be “no IP available.”
4. (Prefix)LATTE_Summary_By_Person: this file consists of a single worksheet named **Summary By Person** that contains a summary for each person of the total number of days of overlap with other persons included in the analysis (*Figure 39*).

Figure 39. Screenshot of the **Summary By Person** worksheet within the **(Prefix)LATTE_Summary_By_Person** output file generated by a LATTE epi link analysis with date data.

Data for the following variables are included in the [\(Prefix\)LATTE_Summary_By_Person](#) output file.

- **ID**: unique person (case or contact) identifier.
 - **Locations**: comma-separated list of all locations where the person corresponding to the specified **ID** had at least one day of overlap with another person (case or contact) included in the analysis.

- Total number of days of certain overlap with another person: the total number of days that the person corresponding to the specified ID overlapped with other persons included in the analysis with certainty (i.e., values of Confidence for Location start and Location end for both persons were “Certain”).
- Total number of days of any overlap with another person: the total number of days that the person corresponding to the specified ID overlapped with other persons included in the analysis irrespective of certainty (i.e., values of Confidence for Location start and Location end for both persons were either “Certain” or “Uncertain”).
- Total number of days of certain overlap with another person during an IP: the total number of days that the person corresponding to the specified ID overlapped during an infectious period with other persons included in the analysis with certainty (i.e., values of Confidence for Location start and Location end for both persons were “Certain”). Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be 0.
- Total number of days of any overlap with another person during an IP: the total number of days that the person corresponding to the specified ID overlapped during an infectious period with other persons included in the analysis irrespective of certainty (i.e., values of Confidence for Location start and Location end for both persons were either “Certain” or “Uncertain”). Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be 0.
- Last date of certain overlap with another person during their IP: the last date that the person corresponding to the specified ID overlapped during an infectious period with other persons included in the analysis with certainty (i.e., values of Confidence for Location start and Location end for both persons were “Certain”). Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be blank.
- Last date of overlap with another person during their IP: the last date that the person corresponding to the specified ID overlapped during an infectious period with other persons included in the analysis irrespective of certainty (i.e., values of Confidence for Location start and Location end for both persons were either “Certain” or “Uncertain”). Because this output file was produced by a LATTE epi link analysis, no Table of infectious periods input file was included in the analysis so values for this variable will be blank.

5. (Prefix)LATTE_Epi_Links_2D: this file consists of a single worksheet named Epi 2D that contains a summary of the total duration of overlap between pairs of persons in one or more locations where they overlapped and the strength of associated epi links (*Figure 40*).

	A	B	C	D	E	F
	ID1	ID2	Strength	Location	Total number of days of certain overlap	Total number of days of any overlap
1						
2	Case 1	Case 3	definite	Homeless shelter A	2	3
3	Case 1	Case 4	probable	Homeless shelter A	1	9
4	Case 1	Contact 2	definite	Homeless shelter A	8	8
5	Case 1	Contact 3	definite	Homeless shelter A	9	9
6	Case 1	Contact 4	probable	Homeless shelter A	0	2
7	Case 1	Contact 6	possible	Homeless shelter A	1	1
8	Case 1	Contact 7	definite	Homeless shelter A	3	4
9	Case 2	Case 3	probable	Homeless shelter A	0	4
10	Case 2	Case 4	probable	Homeless shelter A	0	4
11	Case 2	Contact 1	probable	Homeless shelter A	0	3
12	Case 2	Contact 5	probable	Homeless shelter A	0	4
13	Case 3	Case 4	probable	Homeless shelter A	0	4
14	Case 3	Contact 1	definite	Homeless shelter A	2	4
15	Case 3	Contact 2	definite	Homeless shelter A	6	7
16	Case 3	Contact 4	probable	Homeless shelter A	0	2
17	Case 3	Contact 5	possible	Homeless shelter A	0	1
18	Case 3	Contact 6	definite	Homeless shelter A	4	4
19	Case 3	Contact 7	probable	Homeless shelter A	0	2
20	Case 4	Contact 1	probable	Homeless shelter A	1	2
21	Case 4	Contact 2	probable	Homeless shelter A	1	7
22	Case 4	Contact 4	probable	Homeless shelter A	0	2
23	Case 4	Contact 5	probable	Homeless shelter A	0	3
24	Case 4	Contact 6	possible	Homeless shelter A	0	1
25	Case 4	Contact 7	possible	Homeless shelter A	0	1
26	Contact 1	Contact 2	definite	Homeless shelter A	2	2
27	Contact 1	Contact 3	definite	Homeless shelter A	2	2
28	Contact 1	Contact 4	probable	Homeless shelter A	0	4
29	Contact 1	Contact 5	probable	Homeless shelter A	0	12
30	Contact 1	Contact 6	possible	Homeless shelter A	1	1
31	Contact 1	Contact 7	possible	Homeless shelter A	0	1
32	Contact 2	Contact 4	probable	Homeless shelter A	0	3
33	Contact 2	Contact 6	definite	Homeless shelter A	4	4
34	Contact 2	Contact 7	probable	Homeless shelter A	0	2
35	Contact 4	Contact 7	possible	Homeless shelter A	0	1
36	Contact 6	Contact 7	possible	Homeless shelter A	0	1
37						
38						

Figure 40. Screenshot of the Epi 2D worksheet within the (Prefix)LATTE_Epi_Links_2D output file generated by a LATTE epi link analysis with date data.

Data for the following variables are included in the (Prefix)LATTE_Epi_Links_2D output file.

- **ID1:** unique person (case or contact) identifier for one person in an epi linked pair of persons.
- **ID2:** unique person (case or contact) identifier for the other person in an epi linked pair of persons.
- **Strength:** the strength of the epi link between persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location**. As illustrated in *Figure 3*, if the confidence for both **Location start** and **Location end** for both persons was “Certain” and the combined duration of all “Certain” overlaps was equal to or exceeded the value selected for the **overlap threshold** by the user, **Strength** will be “definite.” If the confidence for either **Location start** or **Location end** for either person was “Uncertain” and the combined duration of all overlaps was equal to or exceeded the value selected for the **overlap threshold** by the user, **Strength** will be “probable.” Finally, if the duration of overlap was less than the value selected for the **overlap threshold** by the user, **Strength** will be “possible.”
- **Location:** comma-separated list of all locations where the persons corresponding to the specified **ID1** and **ID2** overlapped.
- **Total number of days of certain overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** with certainty. If the confidence for both **Location start** and **Location end** for both persons was “Certain” then the value will be “certain.” If either the **Location start** or **Location end** for either person was “Uncertain” then the value will be “uncertain.”
- **Total number of days of any overlap:** total number of days that the persons corresponding to the specified **ID1** and **ID2** overlapped at the specified **Location** irrespective of certainty.

Note that the name of both the file and the worksheet contains the value selected for the **overlap threshold** by the user (here, two days, or “2D”). If the value selected for the **overlap threshold** by the user had been “5,” then the name of this output file would have been (Prefix)LATTE_Epi_Links_5D and the name of the worksheet would have been Epi 5D.

6. **(Prefix)LATTE_Input_IP:** this file consists of a single worksheet named **IP Data** that contains a summary of the estimated infectious period start and end date data uploaded in the **Table of infectious periods** input file (*Figure 22*). See *above* for a description of the variables included in the

(Prefix)LATTE_Input_IP output file. The file will only be generated if a [Table of infectious periods](#) input file was uploaded.

7. [\(Prefix\)LATTE_Gantt_Chart_By_Location](#): this file consists of one or more worksheets each containing a location Gantt chart with a different time interval. The file will only be generated if one or more location Gantt charts was selected for output. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided [below](#).
8. [\(Prefix\)LATTE_Gantt_Chart_IP](#): this file consists of one or more worksheets each containing an IP Gantt chart with a different time interval. The file will only be generated if one or more IP Gantt charts was selected for output. A more detailed explanation of the content of this output file and the format of associated Gantt charts is provided [below](#).

LATTE epi link analysis without date data

A. *Preparing data*

1. Data overview

One type of data, uploaded to LATTE as a single input file, is required for a LATTE epi link analysis without date data.

1. [Table of grouped list\(s\) of people](#): this input file contains information on the persons (cases or contacts) associated with one or more locations included in an analysis. This is essentially a line list.

While not required for a LATTE epi link analysis without date data, data on location-specific epi link strengths can be included as a separate, optional input file.

2. [Table of custom strengths](#): this input file contains information on the location-specific strengths of epi links between persons associated with one or more locations included in an analysis. If only the [Table of grouped list\(s\) of people](#) input file is included, the analysis will apply a single epi link strength to all pairs of persons at all locations included in the analysis. If both the [Table of grouped list\(s\) of people](#) and the [Table of custom strengths](#) input files are included, the analysis will apply a location-specific epi links strength to all pairs of persons at each location included in the analysis.

Separate input file templates (Microsoft Excel files) are available for the [Table of grouped list\(s\) of people](#) and [Table of custom strengths](#) input files. These templates can be downloaded from the [DTBE TB genotyping](#) webpage, which can be accessed using this [*link*](#) or through a link on the LATTE online user interface (see [*Figure 10*](#)). Each template file contains a data worksheet (named [data](#)) into which the data to be analyzed are entered, and a metadata worksheet (named [metadata](#)) that provides information about the names, definition, and formatting of variables included in the [data](#) worksheet. The [data](#) worksheet must be in the first position (i.e., to the left of the [metadata](#) worksheet) as this is the worksheet position from which LATTE pulls data for an analysis.

Note: all screenshots and discussion of analytic outputs presented in this user's manual are based on LATTE analyses of the input files associated with [LATTE training dataset 01](#) and [LATTE training dataset 02](#). These analyses can be replicated by downloading the [LATTE training dataset 01](#) and [LATTE training dataset 02](#) input files (see section on training datasets [*below*](#)) and using them to perform LATTE analyses as described in this user's manual. Additionally, screenshots of the LATTE online user interface presented in this user's manual were taken while running LATTE in the Google Chrome web browser. Note that LATTE seems to consistently perform with few if any issues when used in the Chrome web browser; the LATTE online user interface may appear slightly different in other browsers.

IMPORTANT: DO NOT INCLUDE PERSONALLY IDENTIFIABLE INFORMATION (PII) ABOUT CASES, CONTACTS, OR LOCATIONS

When populating the [Table of grouped list\(s\) of people](#) and [Table of custom strengths](#) input files, deidentified data should be used. Personally identifiable information about cases, contacts, or locations should never be uploaded to CDC servers as part of a LATTE analysis. This is because any information uploaded to a CDC server might be considered a federal record and therefore be subject to disclosure under the federal Freedom of Information Act or other laws. Do not use the real and complete names of cases or contacts or the real and complete names of locations (e.g., schools, shelters, workplaces), especially in geographically small areas. Further, be mindful of situations in which combinations of data can allow for personal identification. Users should endeavor to deidentify potentially identifying information whenever possible (e.g., if the location is a restaurant, consider assigning an identifier like “Restaurant A” or even “Location A” instead of using the name of the restaurant). A separate key to allow translation of generic identifiers back to actual names can be maintained by the user as a separate file that is stored locally (i.e., not on a CDC server).

2. Table of grouped list(s) of people

The [Table of grouped list\(s\) of people](#) input file contains information on persons (cases or contacts) associated with one or more locations included in an analysis. This is essentially a line list. A screenshot of the [Table of grouped list\(s\) of people](#) input file from [LATTE training dataset 02](#) provides an example of how a populated [data](#) worksheet might appear (*Figure 41*).

	A	B	C	D
1	Restaurant A	Library B	Hospital C	School D
2	Person A	Person A	Person D	Person B
3	Person B	Person C	Person E	Person C
4	Person C	Person F	Person G	Person E
5	Person D	Person G	Person J	Person G
6	Person E	Person H		Person I
7		Person I		Person J
8				Person K

Figure 41. Screenshot of a portion of the [data](#) worksheet in the [LATTE training dataset 02 Table of grouped list\(s\) of people](#) input file.

The [data](#) worksheet in the [Table of grouped list\(s\) of people](#) input file must include at least one location and two persons associated with this location (green cells) as described below. Note that more than one location can be included in a single analysis, and more than two persons can be associated with a location.

Required cells (green cells):

1. Each column of the template corresponds to a single location.
2. Enter a unique location identifier in the first cell (A1). Remember that at least one location must be included. It is recommended that users use generic names for locations (e.g., Restaurant A). **Do not include identifiable information about locations.**

- Enter the unique identifier for each person (case or contact) associated with this location in the cells below the name of the location (e.g., cells A2, A3). Enter the identifier for a single person in each cell. Remember that at least two persons must be included for each location. **Do not include personally identifiable information about cases or contacts.**
- Multiple locations can be included in a single analysis. The unique identifier for each location should be entered in the first cell (i.e., row 1) of a separate column, with the unique identifiers for at least two persons associated with that location in the cells below the location identifier. If the unique identifier for a location is listed more than once (i.e., in the first cell of multiple columns), the analysis will stop and an error message will be generated indicating that column names in the [Table of grouped list\(s\) of people](#) must be unique.

3. Table of custom strengths

The [Table of custom strengths](#) contains information on the location-specific strengths of epi links between persons (cases or contacts) associated with one or more locations included in an analysis. A screenshot of the [Table of custom strengths](#) input file from [LATTE training dataset 02](#) provides an example of how a populated [data](#) worksheet might appear (*Figure 42*).

	A	B
1	Variable	Strength
2	Restaurant A	Probable
3	Library B	Possible
4	Hospital C	
5	School D	Definite

Figure 42. Screenshot of a portion of the [data](#) worksheet in the [LATTE training dataset 02 Table of custom strengths](#) input file.

The [data](#) worksheet in the [Table of custom strengths](#) input file includes two required variables (green columns) described below.

Required variables (green columns):

1. Variable: unique location identifier. If a cell in the Variable column is left blank, LATTE will delete the associated row of data during the analysis. Note that values of Variable and the names of locations entered in the Table of grouped list(s) of people input file must match exactly for LATTE to consider these data to be associated with the same location. Location names can be listed in any order. If a value of Variable appears in the Table of custom strengths input file but not in Table of grouped list(s) of people input file, then that value of Variable will be removed from the analysis and this mismatch will be noted in the (Prefix)LATTE_NoDate_Log output file. If a value of Variable appears in the Table of grouped list(s) of people input file but not in the Table of custom strengths input file, all pairs of persons associated with that value of Variable will be assigned a blank value of Strength.
Do not include identifiable information about locations.
2. Strength: location-specific strength of all epi links between persons associated with each value of Variable (location). Options are “Definite,” “Probable,” “Possible” or no strength specified (cell left blank). If another value for Strength is submitted (e.g., “Maybe”), the analysis will stop and an error message will be generated indicating that an invalid value of Strength was submitted.

B. Performing an epi link analysis without date data

A LATTE epi link analysis without date data is performed on the Link analysis without date data tab of the LATTE online user interface (*Figure 43*). This is the second (left to right) of three tabs on the online user interface (A in *Figure 43*).

Location And Time To Epi (LATTE)

A Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)
Table of grouped list(s) of people (required)

No file selected

Set up outputs

Name prefix for output files

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Figure 43. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface. Annotation appears in red.

Clicking on the **Help** (“?”) button (B in *Figure 9*) will reveal a pop up window (A in *Figure 10*) that provides links to LATTE supporting material including the LATTE R source code (hosted on the [TB molecular epidemiology GitHub](#) webpage) and a LATTE user’s manual, training presentation, input file templates (see section on preparing data *above*), and training datasets (see section on training datasets *below*) (hosted on the [DTBE TB genotyping](#) webpage). Alternatively, the [TB molecular epidemiology GitHub](#) webpage can also be accessed using this [link](#) and the [DTBE TB genotyping](#) webpage can also be accessed using this [link](#).

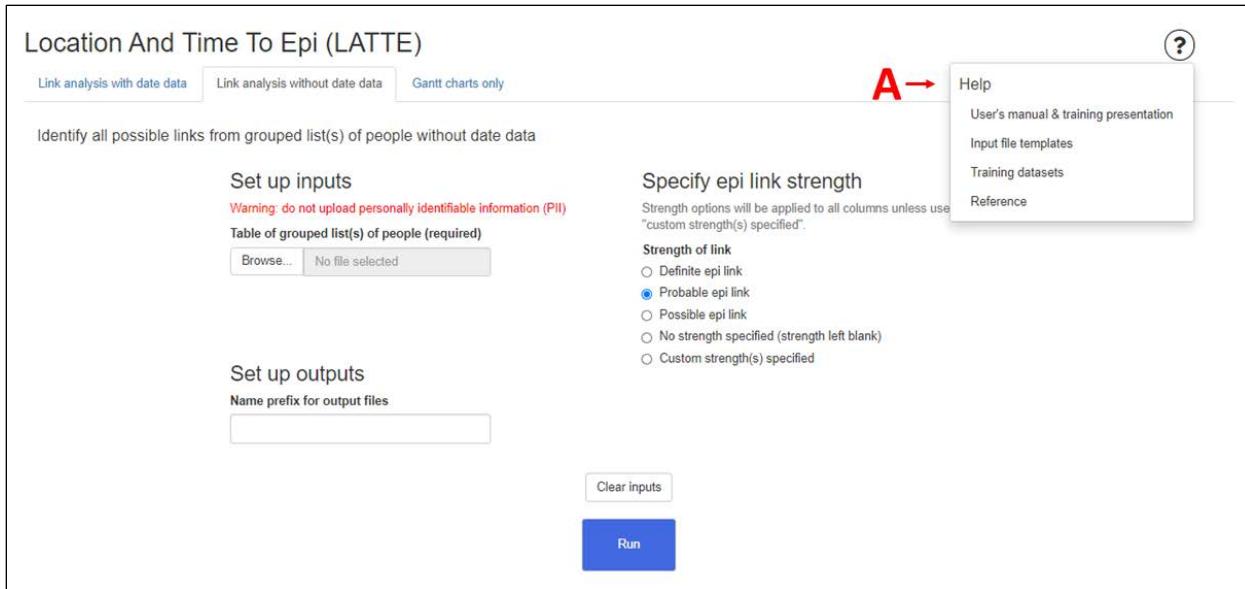


Figure 44. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface showing the pop-up window revealed by clicking the **Help** button. Annotation appears in red.

1. Set up inputs

Only a [Table of grouped list\(s\) of people](#) input file is required to perform a LATTE epi link analysis without date data. To upload a [Table of grouped list\(s\) of people](#) input file, click the [Browse](#) button under “Table of grouped list(s) of people (required)” on the left of the screen (A in *Figure 45*) and select the [Table of grouped list\(s\) of people](#) input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer in any drive or folder that can be accessed via the browser’s finder).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

A→ No file selected

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

Definite epi link
 Probable epi link
 Possible epi link
 No strength specified (strength left blank)
 Custom strength(s) specified

Set up outputs

Name prefix for output files

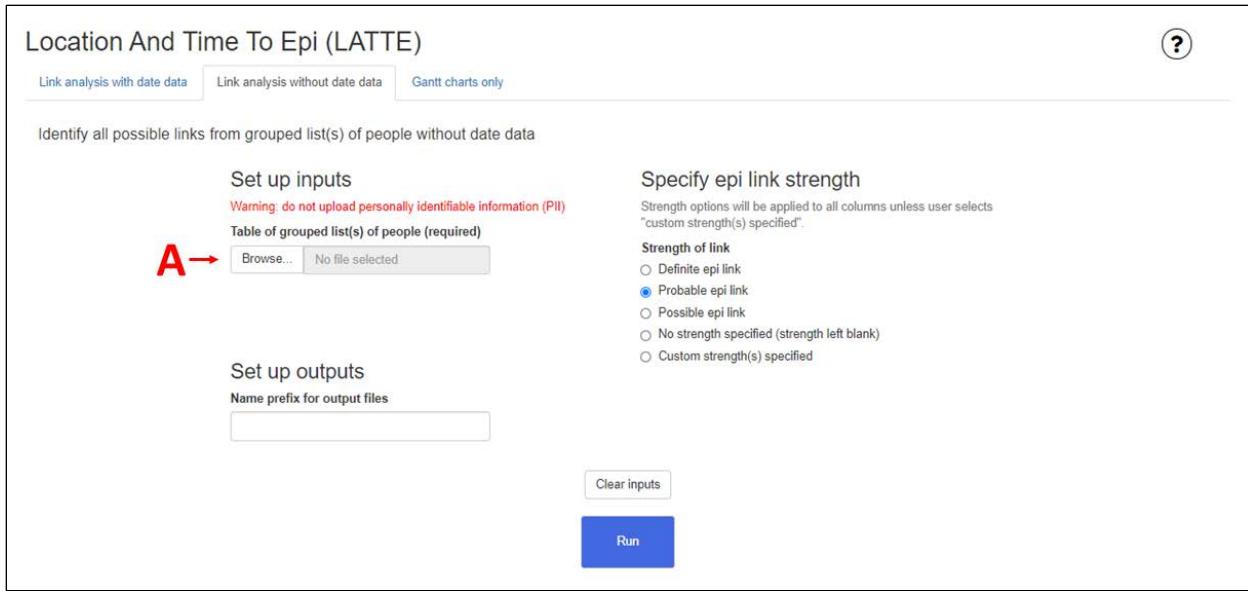


Figure 45. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface showing features to set up inputs. Annotation appears in red.

Once the [Table of grouped list\(s\) of people](#) input file has been successfully uploaded, the file name will appear in the box to the right of the associated [Browse](#) button and a hatched blue bar reading “Upload complete” will appear below the box (*Figure 46*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T Upload complete

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Set up outputs

Name prefix for output files

Clear inputs

Run

Figure 46. Screenshot of the **Link analysis without date data** tab of the LATTE online user interface showing a successfully uploaded **Table of grouped list(s) of people** input file.

2. Set up outputs

After uploading the **Table of grouped list(s) of people** input file, set up outputs by assigning a **Name prefix for output files** generated by the analysis.

1. **Name prefix for output files:** The text entered here (A in *Figure 47*) will form the prefix for the name of the zipped folder that is generated by the analysis and each of the LATTE output files contained within it. Additionally, LATTE will append the text “LATTE” to the name prefix when naming the folder and files. For example, if the text “Example” is entered, the zipped folder generated by the associated LATTE analysis will be named “ExampleLATTE,” and the names of each of the output files contained within it will begin with “ExampleLATTE.” If this field is left blank, output files will not be assigned a name prefix.

The screenshot shows the LATTE online user interface for 'Link analysis without date data'. At the top, there are three tabs: 'Link analysis with date data', 'Link analysis without date data' (which is selected), and 'Gantt charts only'. Below the tabs, a section titled 'Identify all possible links from grouped list(s) of people without date data' contains a 'Set up inputs' section. It includes a warning about personally identifiable information (PII) and a file upload area where 'LATTE_training_dataset_02_T' has been uploaded. To the right is a 'Specify epi link strength' section with options for 'Strength of link' (radio buttons for 'Definite epi link', 'Probable epi link' (selected), 'Possible epi link', 'No strength specified (strength left blank)', and 'Custom strength(s) specified'). Below these are 'Set up outputs' fields for 'Name prefix for output files' (with 'Example' entered) and 'Run' and 'Clear inputs' buttons.

Figure 47. Annotated screenshot of the [Link analysis without date data](#) tab of the LATTE online user interface showing features to set up outputs. Annotation appears in red.

3. Specify epi link strength

After setting up inputs and outputs, specify epi link strength by selecting the desired **Strength of link** for the LATTE epi link analysis without date data.

1. **Strength of link:** the epi link strength(s) are selected here (A in *Figure 48*). If the user selects “Definite epi link,” “Probable epi link,” or “Possible epi link,” LATTE will apply an epi link strength of Definite, Probable, or Possible (respectively) to all epi links between all persons associated with all locations included in the analysis (i.e., non–location-specific strengths). Similarly, if the user selects “No strength specified (strength left blank),” LATTE will not apply an epi link strength to any epi links and the strength field will be left blank. If the user wishes to apply location-specific strengths, “Custom strength(s) specified” should be selected (A in *Figure 49*). This will open a window in which the **Table of custom strengths** input file can be uploaded. To upload a **Table of custom strengths** input file, click the **Browse** button under “Custom strength(s) table” on the right of the screen (B in *Figure 49*) and select the **Table of custom strengths** input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer or network in any drive or folder that can be accessed via the browser’s finder).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T
Upload complete

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

A → Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Set up outputs

Name prefix for output files

Example

Clear inputs

Run

Figure 48. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface showing features to specify epi link strength. Annotation appears in red.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T
Upload complete

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

A → Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Set up outputs

Name prefix for output files

Example

Custom strength(s) table

Valid strength values are definite, probable, possible, or no strength specified (strength left blank).

B → Browse... No file selected

Clear inputs

Run

Figure 49. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface showing features to specify epi link strength. Annotation appears in red.

Once the [Table of custom strengths](#) input file has been successfully uploaded, the file name will appear in the box to the right of the associated [Browse](#) button and a hatched blue bar reading “Upload complete” will appear below the box (*Figure 50*).

The screenshot shows the LATTE online user interface for 'Location And Time To Epi (LATTE)'. The 'Link analysis without date data' tab is active. In the 'Set up inputs' section, there is a warning: 'Warning: do not upload personally identifiable information (PII)'. Below it, a 'Table of grouped list(s) of people (required)' field contains 'LATTE_training_dataset_02_T', with an 'Upload complete' button highlighted in blue. In the 'Specify epi link strength' section, the radio button for 'Custom strength(s) specified' is selected. The 'Custom strength(s) table' section shows a 'Browse...' button and 'LATTE_training_dataset_02_C', with an 'Upload complete' button highlighted in blue. The 'Set up outputs' section has a 'Name prefix for output files' field containing 'Example'. At the bottom, there is a 'Clear inputs' button and a large blue 'Run' button.

Figure 50. Annotated screenshot of the [Link analysis without date data](#) tab of the LATTE online user interface showing a successfully uploaded [Table of custom strengths](#) input file. Annotation appears in red.

While assigning values of [Strength of link](#) to epi links is a subjective process (i.e., there is no single correct way to assign values), assignments should be made consistently across all epi links within a cluster in accordance with some system of formalized, user-defined rules, criteria, or definitions. See Appendix 2 [below](#) for additional details and examples on how to assign values of [Strength of link](#) to epi links.

If different pairs of persons who overlapped at a given location should be associated with different values of [Strength of link](#) (i.e., epi link strengths are specific to pairs of persons rather than locations), select “No strength specified (strength left blank)” for the value of [Strength of link](#) and manually append strength values to the [\(Prefix\)LATTE_NoDate_Pairs](#) output file.

4. Initiating an analysis

Once the [Table of grouped list\(s\) of people](#) input file has been successfully uploaded and analysis parameters have been set, click on the [Run](#) button (A in *Figure 51*) to initiate the LATTE epi link analysis without date data. If the analysis is proceeding successfully, a progress bar will appear in the bottom right corner of the screen above text that reads “Running LATTE” (B in *Figure 51*).

The screenshot shows the 'Location And Time To Epi (LATTE)' interface. At the top, there are three tabs: 'Link analysis with date data' (disabled), 'Link analysis without date data' (selected), and 'Gantt charts only'. Below the tabs, a warning message says 'Identify all possible links from grouped list(s) of people without date data'. The 'Set up inputs' section contains a 'Warning: do not upload personally identifiable information (PII)' message, a 'Table of grouped list(s) of people (required)' field with a 'Browse...' button and 'LATTE_training_dataset_02_T' selected, and an 'Upload complete' button. The 'Specify epi link strength' section includes a note about applying strength to all columns unless 'custom strength(s) specified', a 'Strength of link' radio group (with 'Custom strength(s) specified' selected), and a 'Custom strength(s) table' section with a 'Browse...' button and 'LATTE_training_dataset_02_C' selected, along with an 'Upload complete' button. A 'Clear inputs' button is also present. In the bottom right corner, a red arrow points to the 'Run' button, which is highlighted in blue. Another red arrow points to a progress bar at the bottom right of the screen that displays the text 'Running LATTE'.

Figure 51. Annotated screenshot of the [Link analysis without date data](#) tab of the LATTE online user interface showing an analysis in progress and proceeding successfully. Annotation appears in red.

When the analysis is complete, text that reads “Analysis complete” and a [Download Results](#) button will appear beneath the [Run](#) button (A in *Figure 52*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T
Upload complete

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Custom strength(s) table

Valid strength values are definite, probable, possible, or no strength specified (strength left blank).

Browse... LATTE_training_dataset_02_C
Upload complete

Clear inputs

Run

Analysis complete

A → Download Results

Figure 52. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface after successful completion of a LATTE analysis. Annotation appears in red.

After clicking on the **Download Results** button, an icon of a zipped download file will appear in the bottom left hand corner of the screen if you are using the Google Chrome browser (A in *Figure 53*). Other browsers might have a different way of indicating that a file has been downloaded. Click on this icon to choose the location where the zipped folder containing the results of the LATTE epi link analysis without date data should be saved. Note that after clicking on the **Download Results** button, the specific steps to follow to save results of the analysis, and the appearance of the screen, may vary slightly depending on the browser and browser settings being used.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T
Upload complete

Set up outputs

Name prefix for output files
Example

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Custom strength(s) table
Valid strength values are definite, probable, possible, or no strength specified (strength left blank).

Browse... LATTE_training_dataset_02_C
Upload complete

Clear inputs Run

Download complete
Download Results

ExampleLATTE.zip | ← A | Show all | X

Figure 53. Annotated screenshot of the **Link analysis without date data** tab of the LATTE online user interface after successful completion of a LATTE analysis and clicking on the **Download Results** button. Annotation appears in red.

If the LATTE epi link analysis without date data cannot be successfully completed for some reason, an error message may appear. For example, the message “No people table; please input a table of people in locations” will appear below the **Run** button (A in *Figure 54*) if the **Table of grouped list(s) of people** input file was not successfully uploaded.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Identify all possible links from grouped list(s) of people without date data

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of grouped list(s) of people (required)

Browse... LATTE_training_dataset_02_T Upload complete

Specify epi link strength

Strength options will be applied to all columns unless user selects "custom strength(s) specified".

Strength of link

- Definite epi link
- Probable epi link
- Possible epi link
- No strength specified (strength left blank)
- Custom strength(s) specified

Custom strength(s) table

Valid strength values are definite, probable, possible, or no strength specified (strength left blank).

Browse... No file selected

Set up outputs

Name prefix for output files

Example

B → Clear inputs

Run

A → Error detected:
Custom strength was selected but no table of custom strengths was provided.
Download and view log for more details.

Download Results

Figure 54. Annotated screenshot of the [Link analysis without date data](#) tab of the LATTE online user interface after unsuccessful completion of a LATTE analysis resulting in generation of an error message. Annotation appears in red.

In the event of unsuccessful completion of the LATTE epi link analysis without date data, inspect the input file(s) for proper content and formatting and attempt to repeat the analysis. When ready to repeat the analysis, click on the [Clear inputs](#) button (B in *Figure 54*) to clear any previously uploaded input file(s) from the webpage and then re-upload modified versions of the input file(s).

5. Interpreting analytic outputs

Results of a successful LATTE epi link analysis without date data are downloaded as a single zipped folder. Opening the folder will unzip it and extract between three and four individual LATTE output files (depending on whether a [Table of custom strengths](#) was uploaded as an optional input file). All but one of these files is a Microsoft Excel file. The file names listed below include “(Prefix)” which represents the [Name prefix for output files](#) (A in *Figure 47*) entered by the user.

1. **(Prefix)LATTE_NoDate_Log**: this text file provides a high-level summary of the LATTE epi link analysis without date data (*Figure 55*). It reports the number of columns in the [Table of grouped list\(s\) of people](#) input file (i.e., the number of locations included in the analysis), the [Strength of link](#) specified by the user (non-location specific value or custom strengths specified in the [Table of custom strengths](#) input file), and the number of persons in each column (i.e., associated with each location included in the analysis). If any issues with data quality or completeness were encountered during the analysis, associated changes made by LATTE are detailed. If the analysis stopped unexpectedly due to an error, information on the associated issue(s) may be detailed.

```
LATTE analysis without date data
4 columns found for analysis.
Using strength: custom.
The following row(s) in the table of custom strengths had a missing strength value: 3.
The corresponding pairs of persons will be missing a strength value.
Number of unique people in each column:
Column name          Number
Restaurant A          5
Library B             6
Hospital C            4
School D              7
```

Figure 55. Screenshot of the [\(Prefix\)LATTE_NoDate_Log](#) output file generated by a LATTE epi link analysis without date data.

2. **(Prefix)LATTE_NoDate_Input_People**: this file consists of a single worksheet named [People](#) that contains a summary of the data on stays in locations uploaded in the [Table of grouped list\(s\) of people](#) input file (*Figure 56*).

	A	B	C	D
1	Restaurant A	Library B	Hospital C	School D
2	Person A	Person A	Person D	Person B
3	Person B	Person C	Person E	Person C
4	Person C	Person F	Person G	Person E
5	Person D	Person G	Person J	Person G
6	Person E	Person H		Person I
7		Person I		Person J
8				Person K
9				
10				
11				
12				
13				
14				
15				
16				
17				
<input type="button" value="<"/> <input type="button" value=">"/> <input type="button" value="People"/> <input type="button" value="+"/>				

Figure 56. Screenshot of the **People** worksheet within the **(Prefix)LATTE_NoDate_Input_People** output file generated by a LATTE epi link analysis without date data.

Contents of the **(Prefix)LATTE_NoDate_Input_People** output file should be identical to those of the **Table of grouped list(s) of people** input file (i.e., this file contains information on persons (cases or contacts) associated with one or more locations included in an analysis).

3. **(Prefix)LATTE_NoDate_Pairs:** this file consists of a single worksheet named **Pairs** that contains a summary of all epi links generated by the analysis (*Figure 57*).

	A	B	C	D
1	ID1	ID2	Strength	Label
2	Person A	Person B	probable	Restaurant A
3	Person A	Person C	probable	Restaurant A
4	Person A	Person D	probable	Restaurant A
5	Person A	Person E	probable	Restaurant A
6	Person B	Person C	probable	Restaurant A
7	Person B	Person D	probable	Restaurant A
8	Person B	Person E	probable	Restaurant A
9	Person C	Person D	probable	Restaurant A
10	Person C	Person E	probable	Restaurant A
11	Person D	Person E	probable	Restaurant A
12	Person A	Person C	possible	Library B
13	Person A	Person F	possible	Library B
14	Person A	Person G	possible	Library B
15	Person A	Person H	possible	Library B
16	Person A	Person I	possible	Library B
17	Person C	Person F	possible	Library B
18	Person C	Person G	possible	Library B
19	Person C	Person H	possible	Library B
20	Person C	Person I	possible	Library B
21	Person F	Person G	possible	Library B
22	Person F	Person H	possible	Library B
23	Person F	Person I	possible	Library B
24	Person G	Person H	possible	Library B
25	Person G	Person I	possible	Library B
26	Person H	Person I	possible	Library B
27	Person D	Person E		Hospital C
28	Person D	Person G		Hospital C
29	Person D	Person J		Hospital C
30	Person E	Person G		Hospital C
31	Person E	Person J		Hospital C
32	Person G	Person J		Hospital C
33	Person B	Person C	definite	School D
34	Person B	Person E	definite	School D
35	Person B	Person G	definite	School D
36	Person B	Person I	definite	School D
37	Person B	Person J	definite	School D
38	Person B	Person K	definite	School D
39	Person C	Person E	definite	School D
40	Person C	Person G	definite	School D
41	Person C	Person I	definite	School D
42	Person C	Person J	definite	School D
43	Person C	Person K	definite	School D
44	Person E	Person G	definite	School D
45	Person E	Person I	definite	School D
46	Person E	Person J	definite	School D
47	Person E	Person K	definite	School D
48	Person G	Person I	definite	School D
49	Person G	Person J	definite	School D
50	Person G	Person K	definite	School D
51	Person I	Person J	definite	School D
52	Person I	Person K	definite	School D
53	Person J	Person K	definite	School D

Figure 57. Screenshot of the upper portion of the **Pairs** worksheet within the **(Prefix)LATTE_NoDate_Pairs** output file generated by a LATTE epi link analysis without date data.

Data for the following variables are included in the [\(Prefix\)LATTE_NoDate_Pairs](#) output file.

- **ID1**: unique person (case or contact) identifier for one of the epi-linked pair of people.
- **ID2**: unique person (case or contact) identifier for the other of the epi-linked pair of people.
- **Strength**: the strength of the epi link for the epi-linked pair of people associated with the specified value of **Label** (location).
- **Label**: unique location identifier for the epi-linked pair of people.

Note that an epi-link consists of a combination of two persons and a specific location and that as a result, it is possible for the same combination of two persons to appear multiple times in this table if they overlapped at more than one location.

4. [\(Prefix\)LATTE_NoDate_Input_Strengths](#): this file consists of a single worksheet named **Strengths** that contains a summary of the location-specific values of epi link strength included in the analysis ([Figure 58](#)). It is only generated if the analysis was performed using a [Table of custom strengths](#) input file.

	A	B
1	Variable	Strength
2	Restaurant A	probable
3	Library B	possible
4	Hospital C	
5	School D	definite
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

Strengths

Figure 58. Screenshot of the **Strengths** worksheet within the **(Prefix)LATTE_NoDate_Input_Strengths** output file generated by a LATTE epi link analysis without date data.

Data for the following variables are included in the [\(Prefix\)LATTE_NoDate_Input_Strengths](#) output file; variable values are imported directly from the [Table of custom strengths](#) input file by LATTE. Note, however, that as described above, if a value of [Variable](#) appears in the [Table of custom strengths](#) input file but not in [Table of grouped list\(s\) of people](#) input file, then that value of [Variable](#) will be removed from the analysis and this mismatch will be noted in the [\(Prefix\)LATTE_NoDate_Log](#) output file. If a value of [Variable](#) appears in the [Table of grouped list\(s\) of people](#) input file but not in the [Table of custom strengths](#) input file, all pairs of persons associated with that value of [Variable](#) will be assigned a blank value for [Strength](#).

- [Variable](#): unique location identifier.
- [Strength](#): strength of all epi links between persons associated with each value of [Variable](#) (location).

C. Using analytic outputs

The primary output file from a LATTE epi link analysis without date data, the [\(Prefix\)LATTE_NoDate_Pairs](#) output file, is intended to facilitate the creation and formatting of the [Epi link table](#) input file for analyses using the Logically Inferred Tuberculosis Transmission (LITT) algorithm [3]. LITT automates the integration of information from multiple data streams (e.g., disease surveillance, clinical summaries, epidemiologic investigations, and whole genome sequencing (WGS) with phylogenetic analysis) to identify and rank potential sources of infection for individual TB cases within clusters. More information about and supporting material for LITT is available on the [DTBE TB genotyping](#) webpage, which can be accessed using this [link](#).

LATTE Gantt chart analysis

A. Preparing data

1. Data overview

Either or both of two types of data, each uploaded to LATTE as a separate input file, can be included in a LATTE Gantt chart analysis.

1. **Table of dates in locations:** this input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations) and the user's confidence in this location/date information.
2. **Table of infectious periods:** this input file contains information on the estimated infectious period (IP) start and end dates for one or more cases included in an analysis.

Separate input file templates (Microsoft Excel files) are available for the [Table of dates in locations](#) and [Table of infectious periods](#) input files. These templates can be downloaded from the [DTBE TB genotyping](#) webpage, which can be accessed using this [*link*](#) or through a link on the LATTE online user interface (see [*Figure 10*](#)). Each template file contains a data worksheet (named [data](#)) into which the data to be analyzed are entered, and a metadata worksheet (named [metadata](#)) that provides information about the names, definition, and formatting of variables included in the [data](#) worksheet. The [data](#) worksheet must be in the first position (i.e., to the left of the [metadata](#) worksheet) as this is the worksheet position from which LATTE pulls data for an analysis.

Note: all screenshots and discussion of analytic outputs presented in this user's manual are based on LATTE analyses of the input files associated with [LATTE training dataset 01](#) and [LATTE training dataset 02](#). These analyses can be replicated by downloading the [LATTE training dataset 01](#) and [LATTE training dataset 02](#) input files (see section on training datasets [*below*](#)) and using them to perform LATTE analyses as described in this user's manual. Additionally, screenshots of the LATTE online user interface presented in this user's manual were taken while running LATTE in the Google Chrome web browser. Note that LATTE seems to consistently perform with few if any issues when used in the Chrome web browser; the LATTE online user interface may appear slightly different in other browsers.

IMPORTANT: DO NOT INCLUDE PERSONALLY IDENTIFIABLE INFORMATION (PII) ABOUT CASES, CONTACTS, OR LOCATIONS

When populating the [Table of dates in locations](#) and [Table of infectious periods](#) input files, deidentified data should be used. Personally identifiable information about cases, contacts, or locations should never be uploaded to CDC servers as part of a LATTE analysis. This is because any information uploaded to a CDC server might be considered a federal record and therefore be subject to disclosure under the federal Freedom of Information Act or other laws. Do not use the real and complete names of cases or contacts as values for [ID](#) or the real and complete names of locations (e.g., schools, shelters, workplaces) as values for [Location](#), especially in geographically small areas. Further, be mindful of situations in which

combinations of data can allow for personal identification. Users should endeavor to deidentify potentially identifying information whenever possible (e.g., if the location is a restaurant, consider assigning an identifier like “Restaurant A” or even “Location A” instead of using the name of the restaurant). A separate key to allow translation of generic identifiers back to actual names can be maintained by the user as a separate file that is stored locally (i.e., not on a CDC server).

1. Table of dates in locations

The [Table of dates in locations](#) input file contains information on the start and end dates when persons (cases or contacts) included in an analysis were present at one or more locations (i.e., dates of stays in locations). A screenshot of the [Table of dates in locations](#) input file from [LATTE training dataset 01](#) provides an example of how a populated [data](#) worksheet might appear ([Figure 6](#)). See the section [above](#) associated with a LATTE IP epi link analysis with date data for instructions on how to populate a [Table of dates in locations](#).

2. Table of infectious periods

The [Table of infectious periods](#) input file contains information on the estimated infectious period start dates and infectious period end dates for one or more persons (here, cases) included in an analysis. A screenshot of the [Table of infectious periods](#) input file from [LATTE training dataset 01](#) provides an example of how a populated [data](#) worksheet might appear ([Figure 7](#)). See the section [above](#) associated with a LATTE IP epi link analysis with date data for instructions on how to populate a [Table of infectious periods](#).

B. Performing a Gantt chart analysis

A LATTE Gantt chart analysis is performed on the [Gantt charts only](#) tab of the LATTE online user interface ([Figure 59](#)). This is the third (left to right) of three tabs on the online user interface (A in [Figure 59](#)).

A Location And Time To Epi (LATTE)

B → ?

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

No file selected

Table of infectious periods (IP) (required for IP Gantt chart)

No file selected

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Figure 59. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface.
Annotation appears in red.

Clicking on the [Help](#) (“?”) button (B in [Figure 9](#)) will reveal a pop up window (A in [Figure 10](#)) that provides links to LATTE supporting material including the LATTE R source code (hosted on the [TB molecular epidemiology GitHub](#) webpage) and a LATTE user’s manual, training presentation, input file templates (see section on preparing data [above](#)), and training datasets (see section on training datasets [below](#)) (hosted on the [DTBE TB genotyping](#) webpage). Alternatively, the [TB molecular epidemiology GitHub](#) webpage can also be accessed using this [link](#) and the [DTBE TB genotyping](#) webpage can also be accessed using this [link](#).

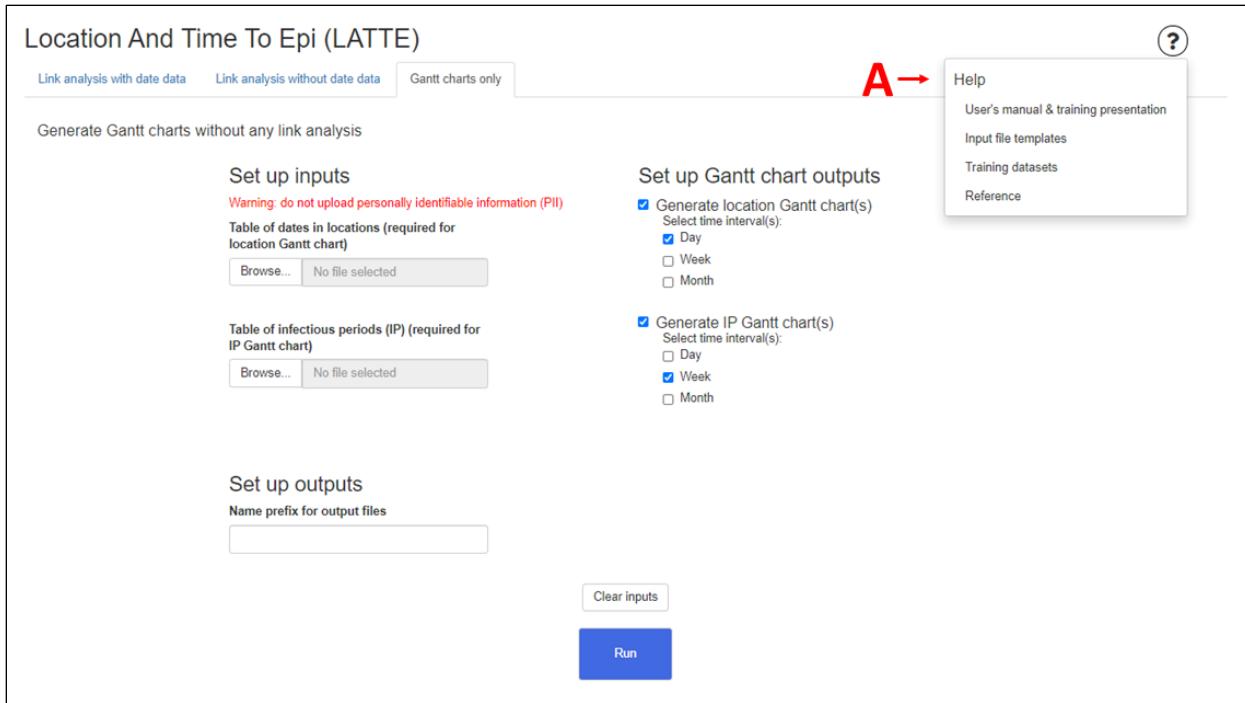


Figure 60. Annotated screenshot of the Gantt charts only tab of the LATTE online user interface showing the pop-up window revealed by clicking the Help button. Annotation appears in red.

1. Set up inputs

Either a [Table of dates in locations](#) input file or a [Table of infectious periods](#) input file, or both, can be included in a LATTE Gantt chart analysis. To upload a [Table of dates in locations](#) input file, click the [Browse](#) button under “Table of dates in locations (required for location Gantt chart)” on the left of the screen (A in [Figure 61](#)) and select the [Table of dates in locations](#) input file from the finder window (i.e., all LATTE input files can be stored on the user’s local computer in any drive or folder that can be accessed via the finder). To upload a [Table of infectious periods](#) input file, click the [Browse](#) button under “Table of infectious periods (IP) (required for IP Gantt chart)” on the left of the screen (B in [Figure 61](#)) and select the [Table of infectious periods](#) input file from the finder window.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

A→ No file selected

Table of infectious periods (IP) (required for IP Gantt chart)

B→ No file selected

Set up Gantt chart outputs

Generate location Gantt chart(s)
 Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
 Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Figure 61. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface showing features to set up inputs. Annotation appears in red.

Once either a [Table of dates in locations](#) input file or a [Table of infectious periods](#) input file, or both, has been successfully uploaded, the file name will appear in the box to the right of the associated [Browse](#) button and a hatched blue bar reading “Upload complete” will appear below the box (*Figure 62*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files

Clear inputs

Run

Figure 62. Screenshot of the **Gantt charts only** tab of the LATTE online user interface showing successfully uploaded **Table of dates in locations** and **Table of infectious periods** input files.

2. Set up outputs

After uploading either a **Table of dates in locations** input file or a **Table of infectious periods** input file, or both, set up outputs by assigning a **Name prefix for output files** generated by the LATTE Gantt chart analysis.

1. **Name prefix for output files:** The text entered here (A in *Figure 63*) will form the prefix for the name of the zipped folder that is generated by the analysis and each of the LATTE output files contained within it. Additionally, LATTE will append the text “LATTE” to the name prefix when naming the folder and files. For example, if the text “Example” is entered, the zipped folder generated by the associated LATTE analysis will be named “ExampleLATTE,” and the names of each of the output files contained within it will begin with “ExampleLATTE.” If this field is left blank, output files will not be assigned a name prefix.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

Clear inputs

Run

Figure 63. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface showing features to set up outputs. Annotation appears in red.

3. Set up Gantt chart outputs

After setting up inputs and outputs, set up Gantt chart outputs by selecting the type(s) of Gantt charts to be output by the analysis.

1. **Generate location Gantt chart(s):** this box should be checked if the user wants to output one or more Gantt charts showing dates of stays in locations (and estimated dates of infectious periods if a [Table of infectious periods](#) input file was uploaded) (A in *Figure 64*). When this box is checked, the time interval(s) (i.e., temporal resolution) for the location Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s). A [Table of dates in locations](#) input file must be uploaded in order to perform a Gantt chart analysis to produce one or more location Gantt charts.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Set up outputs

Name prefix for output files
Example

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

← A ← B

Clear inputs Run

Figure 64. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface showing features to set up Gantt chart outputs. Annotation appears in red.

2. **Generate IP Gantt chart(s):** this box should be checked if the user wants to output one or more Gantt charts showing estimated dates of infectious periods (B in *Figure 64*). When this box is checked, the time interval(s) (i.e., temporal resolution) for the IP Gantt chart(s) must also be selected. Time interval options are day, week, and month. One or more time intervals must be selected by checking the box associated with the desired time interval(s). A **Table of infectious periods** input file must be uploaded in order to perform a Gantt chart analysis to produce one or more location Gantt charts.

4. Initiating an analysis

Once either a **Table of dates in locations** input file or a **Table of infectious periods** input file, or both, has been successfully uploaded and analysis parameters have been set, click on the **Run** button (A in *Figure 65*) to initiate the LATTE Gantt chart analysis. If the analysis is proceeding successfully, a progress bar will appear in the bottom right corner of the screen above text that reads “Running LATTE” (B in *Figure 65*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

Clear inputs

A → Run

B → Running LATTE

Figure 65. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface showing an analysis in progress and proceeding successfully. Annotation appears in red.

When the analysis is complete, text that reads “Analysis complete” and a [Download Results](#) button will appear beneath the [Run](#) button (A in *Figure 66*).

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

Clear inputs

Run

Analysis complete

A → Download Results

Figure 66. Annotated screenshot of the Gantt charts only tab of the LATTE online user interface after successful completion of a LATTE analysis. Annotation appears in red.

After clicking on the [Download Results](#) button, an icon of a zipped download file will appear in the bottom left hand corner of the screen if you are using the Google Chrome browser (A in *Figure 67*). Other browsers might have a different way of indicating that a file has been downloaded. Click on this icon to choose the location where the zipped folder containing the results of the LATTE Gantt chart analysis should be saved. Note that after clicking on the [Download Results](#) button, the specific steps to follow to save results of the analysis, and the appearance of the screen, may vary slightly depending on the browser and browser settings being used.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... LATTE_training_dataset_01_T Upload complete

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

Clear inputs

Run

Download complete

Download Results

ExampleLATTE.zip

A

Show all X

Figure 67. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface after successful completion of a LATTE analysis and clicking on the **Download Results** button. Annotation appears in red.

If the LATTE Gantt chart analysis cannot be successfully completed for some reason, an error message may appear. For example, the message “No IP data; please input an IP table or deselect the IP Gantt chart options” will appear below the **Run** button (A in *Figure 68*) if one or more IP Gantt charts was selected to be output but a **Table of infectious periods** input file was not successfully uploaded.

Location And Time To Epi (LATTE)

Link analysis with date data Link analysis without date data Gantt charts only

Generate Gantt charts without any link analysis

Set up inputs

Warning: do not upload personally identifiable information (PII)

Table of dates in locations (required for location Gantt chart)

Browse... LATTE_training_dataset_01_T
Upload complete

Table of infectious periods (IP) (required for IP Gantt chart)

Browse... No file selected

Set up Gantt chart outputs

Generate location Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Generate IP Gantt chart(s)
Select time interval(s):
 Day
 Week
 Month

Set up outputs

Name prefix for output files
Example

B → Clear inputs

A → No IP data; please input an IP table or deselect the IP Gantt chart options

Run

Figure 68. Annotated screenshot of the **Gantt charts only** tab of the LATTE online user interface after unsuccessful completion of a LATTE analysis resulting in generation of an error message. Annotation appears in red.

In the event of unsuccessful completion of the LATTE Gantt chart analysis, inspect the input file(s) for proper content and formatting and attempt to repeat the analysis. When ready to repeat the analysis, click on the [Clear inputs](#) button (B in *Figure 68*) to clear any previously uploaded input file(s) from the webpage and then re-upload modified versions of the input file(s).

5. Interpreting analytic outputs

Results of a successful LATTE Gantt chart analysis are downloaded as a single zipped folder. Opening the folder will unzip it and extract three or five individual LATTE output files (depending on whether one or more location Gantt charts, one or more IP Gantt charts, or both types of Gantt charts, were selected to be output). All but one of these files is a Microsoft Excel file. The file names listed below include “(Prefix)” which represents the [Name prefix for output files](#) (A in *Figure 63*) entered by the user.

1. [\(Prefix\)LATTE_Log](#): this text file provides a high-level summary of the LATTE Gantt chart analysis ([Figure 69](#)). It reports the type(s) of Gantt charts selected to be output and the associated time interval(s) selected. If any issues with data quality or completeness were encountered during the analysis, associated changes made by LATTE are detailed. If the analysis stopped unexpectedly due to an error, information on the associated issue(s) may be detailed.

```
Gantt charts only
Generating location Gantt chart for these time intervals: day, week, month
Generating IP Gantt chart for these time intervals: day, week, month
```

Figure 69. Screenshot of the [\(Prefix\)LATTE_Log](#) output file generated by a LATTE Gantt chart analysis.

2. [\(Prefix\)LATTE_Gantt_Chart_By_Location](#): this file consists of one or more worksheets that each contain a location Gantt chart. A LATTE Gantt chart analysis will produce a separate location Gantt chart (and thus, a separate worksheet in the [Gantt_Chart_By_Location](#) output file) for every combination of time interval selected for the analysis and unique location included in the [Table of dates in locations](#) input file. For example, if a user performing a Gantt chart analysis checked the [Generate location Gantt chart\(s\)](#) box and selected two time intervals (day, week), and the [Table of dates in locations](#) input file included dates of stay associated with two locations (Restaurant A, School A) then the [\(Prefix\)LATTE_Gantt_Chart_By_Location](#) output file would contain four worksheets: 1) Restaurant A by day; 2) Restaurant A by week; 3) School A by day; 4) School A by week.

Location Gantt charts list dates across columns; for a location Gantt chart with a time interval of day, individual days within months are listed ([Figure 70](#)). Person identifiers are listed in the first column on the left, with three rows allotted to each person. The first row is used to visualize dates of stays in locations. Cells shaded black in the first row indicate that the user felt certain about a date while cells shaded grey indicate that the user felt uncertain about a date. The second row is used to visualize estimated dates of infectious periods. If a [Table of infectious periods](#) input file was uploaded, cells shaded red in the second row indicate that the user estimated that a date was part of a case's infectious period. If a [Table of infectious periods](#) input file was not uploaded, cells in the second row will be blank. The third row is used as a visual spacer between persons; cells in the third row are always blank.

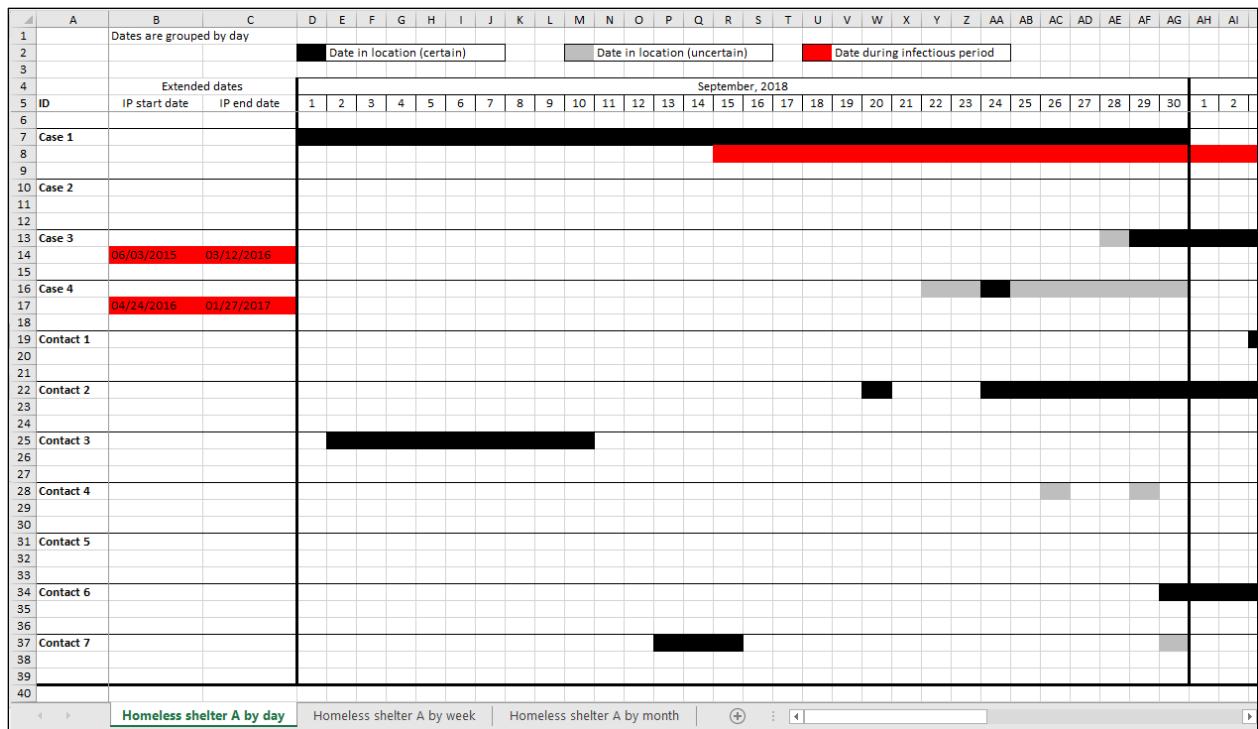


Figure 70. Screenshot of a portion of a worksheet within the (Prefix)LATTE_Gantt_Chart_By_Location output file containing a location Gantt chart with a time interval of day generated by a LATTE Gantt chart analysis.

A location Gantt chart begins and ends with the earliest and latest dates (here, days) of stays at a location, respectively. If a [Table of infectious periods](#) input file was uploaded and a case's estimated infectious period started or ended either before the first date of stay in a location or after the last date of stay in a location, these estimated infectious period dates will be indicated on the far left- or right-hand sides of the chart ([Figure 71](#), [Figure 72](#)). Cells in these columns are shaded red and contain the estimated infectious period start or end dates.

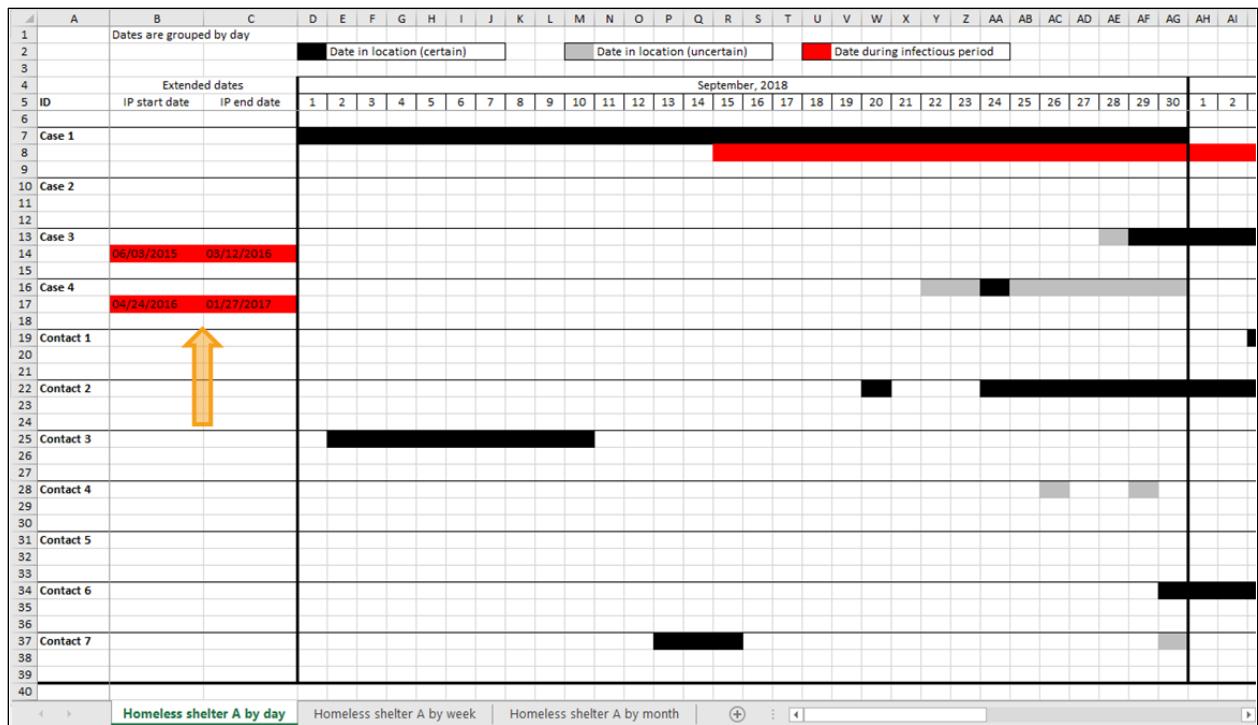


Figure 71. Annotated screenshot of a portion of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_By_Location](#) output file containing a location Gantt chart with a time interval of day generated by a LATTE Gantt chart analysis. Annotation appears as an orange arrow.



Figure 72. Annotated screenshot of a portion of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_By_Location](#) output file containing a location Gantt chart with a time interval of day generated by a LATTE Gantt chart analysis. Annotation appears as an orange arrow.

For a location Gantt chart with a time interval of week, individual weeks within years are listed across columns (*Figure 73*). Week identifiers denote Morbidity and Mortality Weekly Report (MMWR) week. MMWR week is the week of the epidemiologic year for which the National Notifiable Diseases Surveillance System (NNDSS) disease report is assigned for the purposes of MMWR disease incidence reporting and publishing. MMWR weeks run from Sunday to Saturday and associated values range from 1 to 53, although most years consist of 52 weeks.

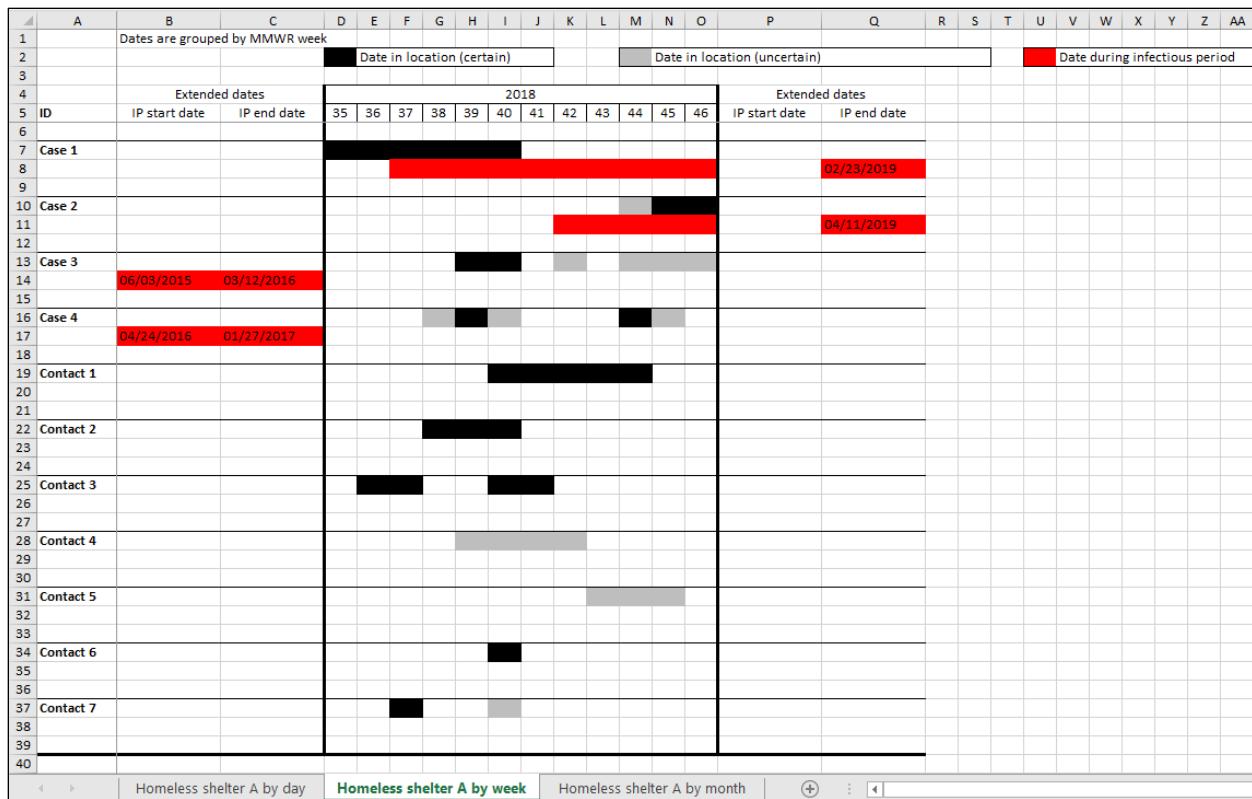


Figure 73. Screenshot of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_By_Location](#) output file containing a location Gantt chart with a time interval of week generated by a LATTE Gantt chart analysis.

Location Gantt charts with a time interval of week have the same general format as location Gantt charts with a time interval of day, with person identifiers listed in the first column on the left, three rows allotted to each person, and dates in locations and estimated dates of infectious periods (if a [Table of infectious periods](#) input file was uploaded) visualized in the first and second rows, respectively (*Figure 73*). In location Gantt charts with a time interval of week, if a person was present at a location for at least one day of an MMWR week, the person will be considered present at that location during that MMWR week. Further, if the user felt certain that the person was present at the location on at least one day during an MMWR week, the person will be considered present with certainty during that MMWR week and the corresponding cell in the chart will be shaded black. If the person was present at the location for one or more days during an MMWR week, but the user was uncertain about all of those dates of stay (in other words, there were not days where the user was certain the person was at the location during the week) then the person will be considered present with uncertainty during that MMWR week and the corresponding cell in the chart will be shaded grey.

As with location Gantt charts with a time interval of day, location Gantt charts with a time interval of week begin and end with the earliest and latest dates (here, weeks) of stays at a location, respectively. If a [Table of infectious periods](#) input file was uploaded and a case's estimated infectious period started or ended either before the first date of stay in a location or after the last date of stay in a location, these estimated infectious period dates will be indicated on the far left- or right-hand sides of the chart ([Figure 73](#)). Cells in these columns are shaded red and contain the estimated infectious period start or end dates.

For a location Gantt chart with a time interval of month, individual months within years are listed across columns ([Figure 74](#)). Month values range from 1 to 12.

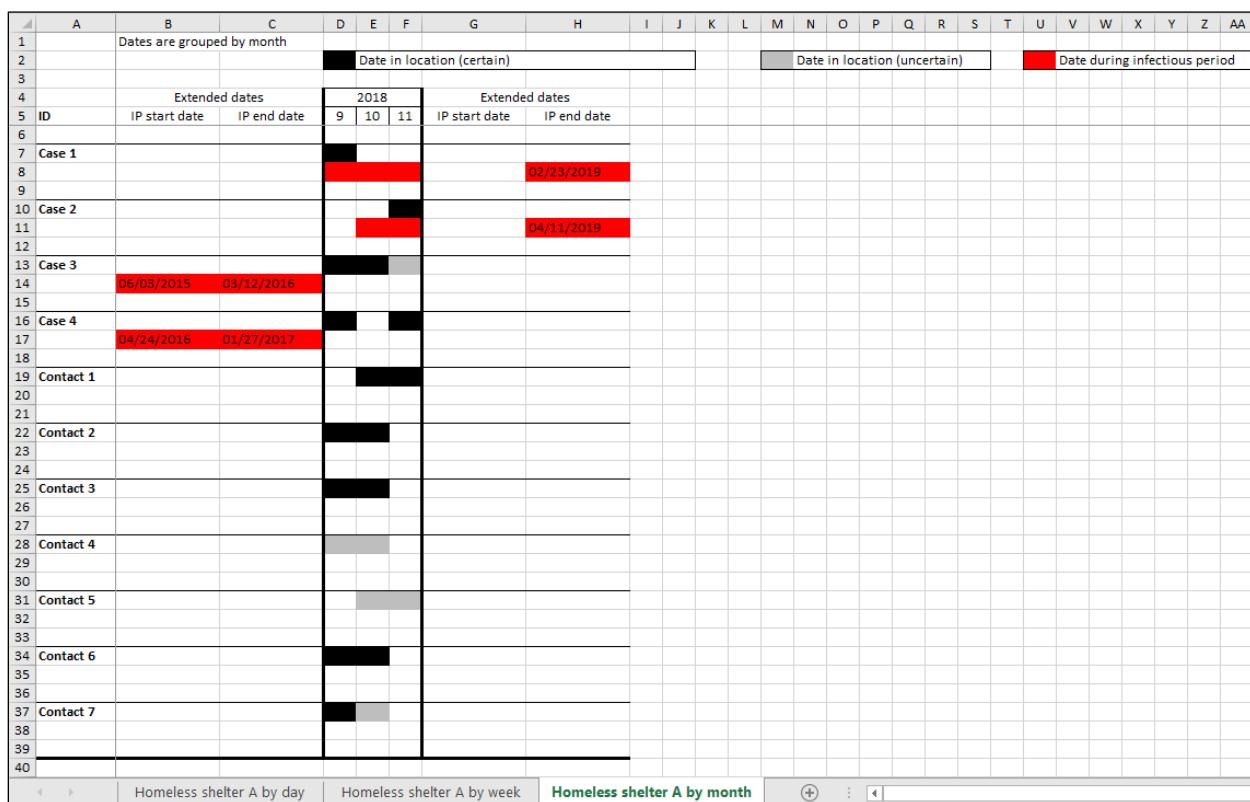


Figure 74. Screenshot of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_By_Location](#) output file containing a location Gantt chart with a time interval of month generated by a LATTE Gantt chart analysis.

Location Gantt charts with a time interval of month have the same general format as location Gantt charts with time intervals of day and week, with person identifiers listed in the first column on the left, three rows allotted to each person, and dates in locations and estimated dates of infectious periods (if a [Table of infectious periods](#) input file was uploaded and a case's estimated infectious period started or ended either before the first date of stay in a location or after the last date of stay in a location, these estimated infectious period dates will be indicated on the far left- or right-hand sides of the chart ([Figure 73](#))). Cells in these columns are shaded red and contain the estimated infectious period start or end dates.

[infectious periods](#) input file was uploaded) visualized in the first and second rows, respectively (*Figure 74*). In location Gantt charts with a time interval of month, if a person was present at a location for at least one day of a month, the person will be considered present at that location during that month. Further, if the user felt certain that the person was present at the location on at least one day during a month, the person will be considered present with certainty during that month and the corresponding cell in the chart will be shaded black. If the person was present at the location for one or more days during a month, but the user was uncertain about all of those dates of stay (in other words, there were not days where the user was certain the person was at the location during the month) then the person will be considered present with uncertainty during that month and the corresponding cell in the chart will be shaded grey.

As with location Gantt charts with a time interval of day and week, location Gantt charts with a time interval of month begin and ends with the earliest and latest dates (here, months) of stays at a location, respectively. If a [Table of infectious periods](#) input file was uploaded and a case's estimated infectious period started or ended either before the first date of stay in a location or after the last date of stay in a location, these estimated infectious period dates will be indicated on the far left- or right-hand sides of the chart (*Figure 74*). Cells in these columns are shaded red and contain the estimated infectious period start or end dates.

3. [\(Prefix\)LATTE_Gantt_Chart_IP](#): this file consists of one or more worksheets that each contain an IP Gantt chart. A LATTE Gantt chart analysis will produce a separate IP Gantt chart (and thus, a separate worksheet in the [Gantt_Chart_IP](#) output file) for every time interval selected for the analysis involving dates in the [Table of infectious periods](#) input file. For example, if a user performing a Gantt chart analysis checked the [Generate IP Gantt chart\(s\)](#) box and selected two time intervals (day, week), then the [\(Prefix\)LATTE_Gantt_Chart_IP](#) output file would contain two worksheets: 1) IP by day; 2) IP by week.

IP Gantt charts list dates across columns; for an IP Gantt chart with a time interval of day, individual days within months are listed (*Figure 75*). Person identifiers are listed in the first column on the left, with one row allotted to each person. Cells shaded red in the row indicate that the user estimated that a date was part of a case's infectious period. An IP Gantt chart begins and ends with the earliest and latest estimated dates (here, days) of infectious periods, respectively.

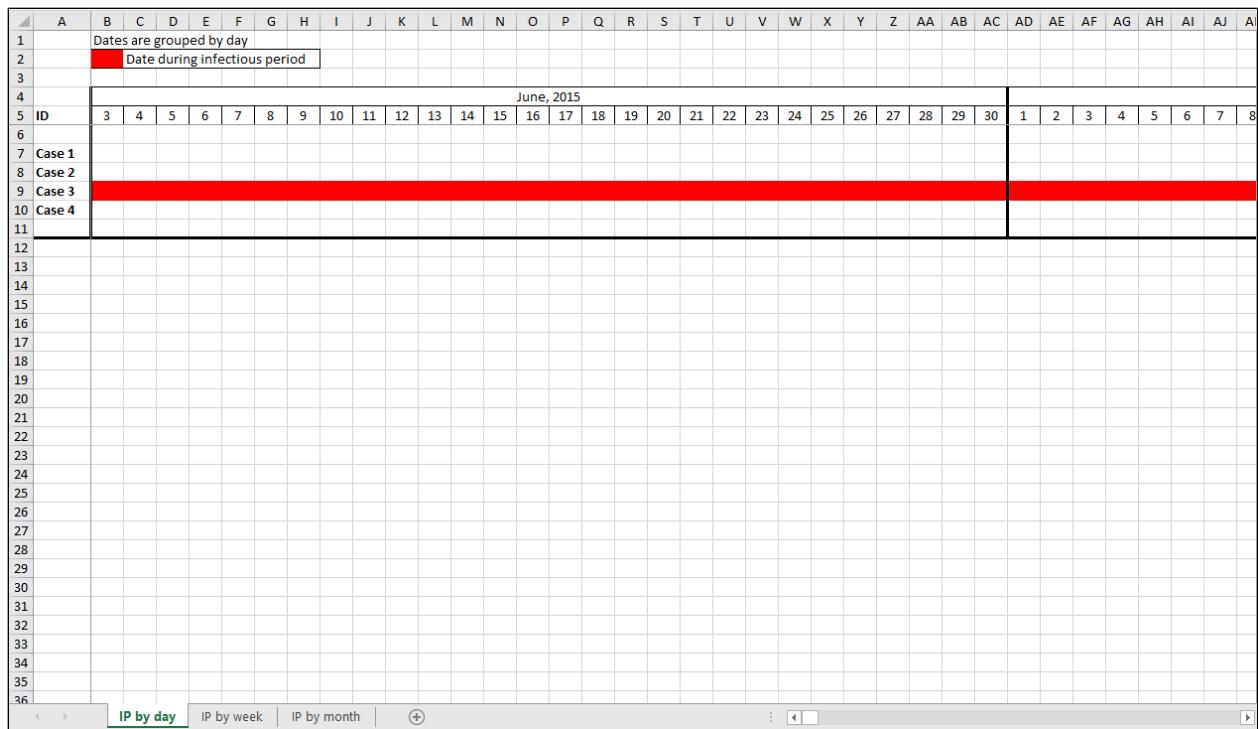


Figure 75. Screenshot of a portion of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_IP](#) output file containing an IP Gantt chart with a time interval of day generated by a LATTE Gantt chart analysis.

For an IP Gantt chart with a time interval of week, individual weeks within years are listed across columns (*Figure 76*). Week identifiers denote Morbidity and Mortality Weekly Report (MMWR) week. MMWR week is the week of the epidemiologic year for which the National Notifiable Diseases Surveillance System (NNDSS) disease report is assigned for the purposes of MMWR disease incidence reporting and publishing. MMWR weeks run from Sunday to Saturday and associated values range from 1 to 53, although most years consist of 52 weeks. IP Gantt charts with a time interval of week have the same general format as IP Gantt charts with a time interval of day, with person identifiers listed in the first column on the left and one row allotted to each person. In IP Gantt charts with a time interval of week, if a case's infectious period was estimated to include at least one day of an MMWR week, the case's infectious period will be considered to include that MMWR week and the corresponding cell in the chart will be shaded red.

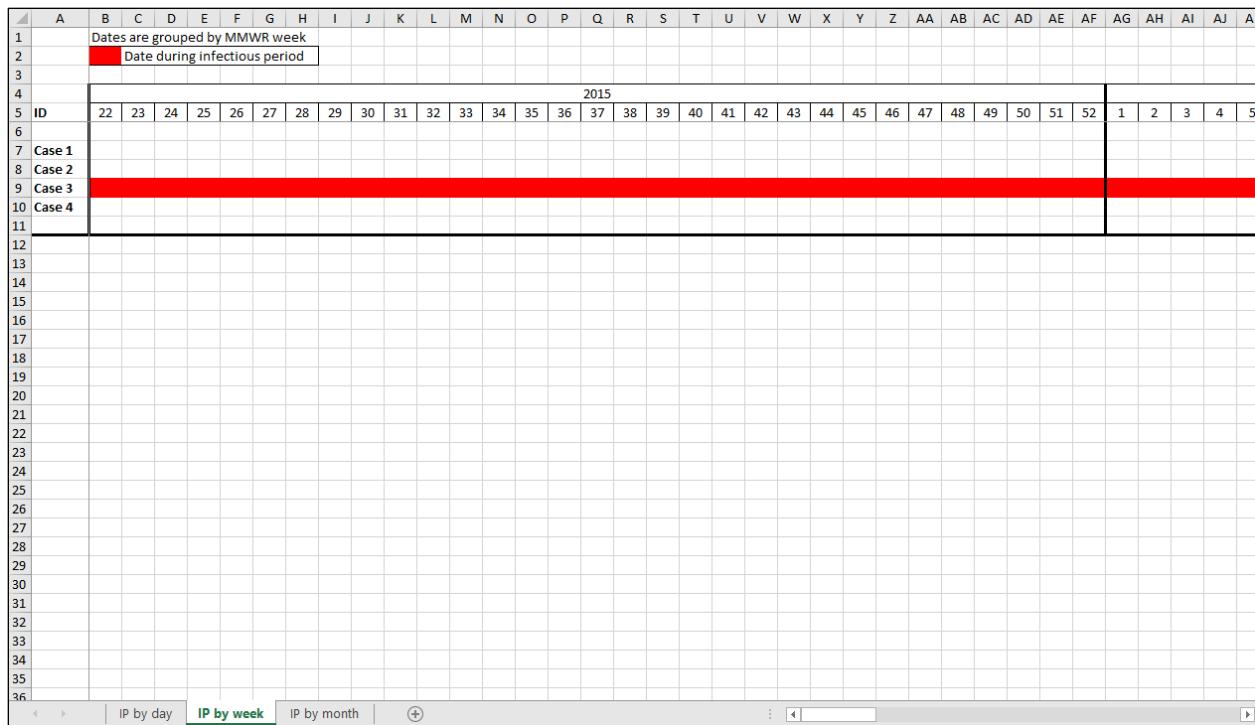


Figure 76. Screenshot of a portion of a worksheet within the [\(Prefix\)LATTE_Gantt_Chart_IP](#) output file containing an IP Gantt chart with a time interval of week generated by a LATTE Gantt chart analysis.

For an IP Gantt chart with a time interval of month, individual months within years are listed across columns (*Figure 77*). Month values range from 1 to 12. IP Gantt charts with a time interval of month have the same general format as IP Gantt charts with time intervals of day and week, with person identifiers listed in the first column on the left and one row allotted to each person. In IP Gantt charts with a time interval of month, if a case's infectious period was estimated to include at least one day of a month, the case's infectious period will be considered to include that month and the corresponding cell in the chart will be shaded red.

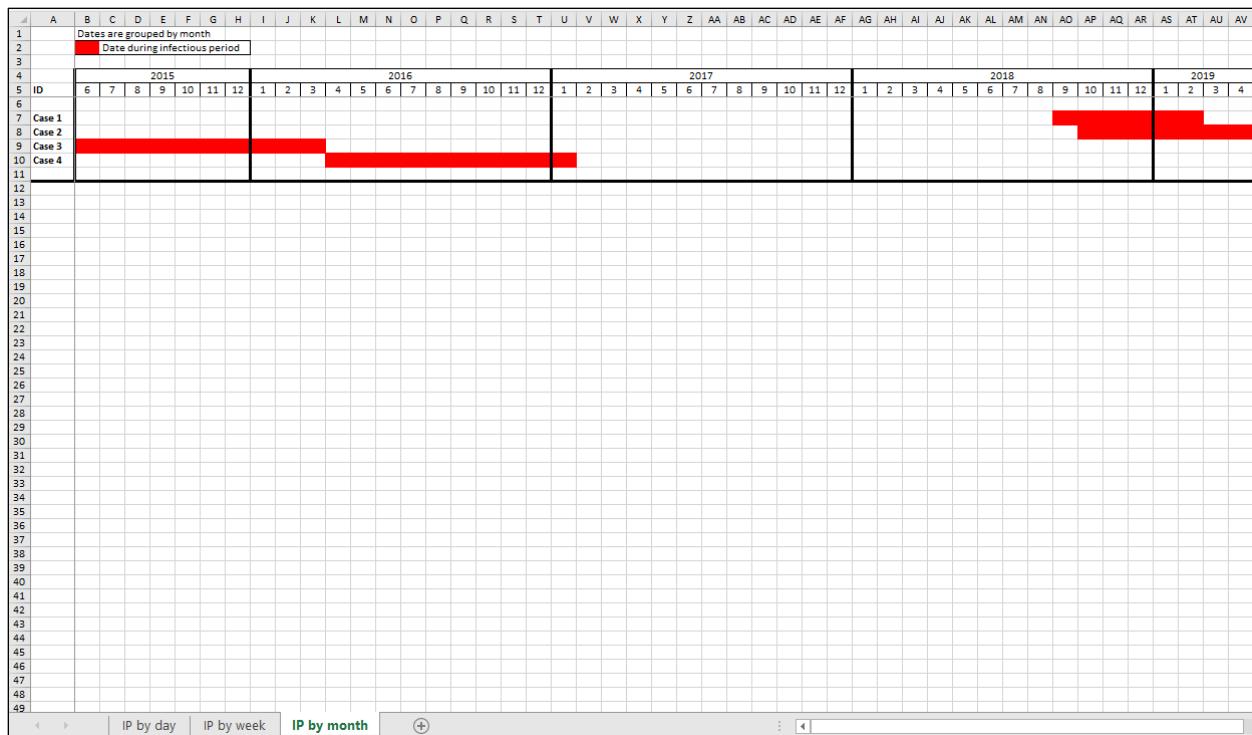


Figure 77. Screenshot of a worksheet within the **(Prefix)LATTE_Gantt_Chart_IP** output file containing an IP Gantt chart with a time interval of month generated by a LATTE Gantt chart analysis.

4. **(Prefix)LATTE_Input_Dates:** this file consists of a single worksheet named **Location Data** that contains a summary of the data on dates of stays in locations uploaded in the **Table of dates in locations** input file (*Figure 21*). See *above* for a description of the variables included in the **(Prefix)LATTE_Input_Dates** output file. The file will only be generated if a **Table of dates in locations** input file was uploaded.
 5. **(Prefix)LATTE_Input_IP:** this file consists of a single worksheet named **IP Data** that contains a summary of the estimated infectious period start and end date data uploaded in the **Table of infectious periods** input file (*Figure 22*). See *above* for a description of the variables included in the **(Prefix)LATTE_Input_IP** output file. The file will only be generated if a **Table of infectious periods** input file was uploaded.

C. Using analytic outputs

Output files from a LATTE Gantt chart analysis can provide helpful visualizations of date data that can be used to determine when persons under investigation had overlapping stays at one or more locations and especially when those overlapping stays might have coincided with a case's infectious period. This information can be highly useful in identifying and prioritizing persons for follow up during contact and cluster investigations. For example, in the location Gantt chart presented in *Figure 70*, it is readily apparent that during September 2018, Contact 2 and Contact 3 both overlapped with Case 1 at Homeless shelter A for over 8 days. It is also apparent that while all of the overlap between Contact 2 and Case 1 occurred during Case 1's estimated infectious period, all of the overlap between Contact 3 and Case 1 occurred prior to the start of Case 1's estimated infectious period. Based on these date data, public health officials would likely be more concerned about and prioritize follow up with Contact 2 compared to Contact 3.

LATTE Gantt charts can also provide insights into sources of infection in transmission networks. For example, in the IP Gantt chart presented in *Figure 77*, it is readily apparent that the estimated infectious periods for Case 1 and Case 2 began well after the estimated infectious periods for Case 3 and Case 4. Based on this information, public health officials might conclude that neither Case 3 or Case 4 were likely to have been infected by either Case 1 or Case 2 at Homeless shelter A.

Limitations

When interpreting outputs of a LATTE analysis, users should be mindful of at least two limitations, the first of which is related to data completeness and quality. As an example, the accuracy of epi links and IP epi links identified by LATTE is contingent on users having complete and correct records of dates in locations for persons included in an analysis. Conducting thorough, systematic, and rigorous epidemiologic and contact investigations, and carefully managing associated data, represent the best approaches to overcoming this potential limitation. The second limitation is related to the granularity of temporal data. In its current form, LATTE evaluates temporal data at a minimum interval of one day. This can create complications when persons included in an analysis are present at locations for fewer than 24 hours. Under these circumstances, data formatted for a LATTE analysis may appear to indicate that two persons overlapped at a location when in reality they did not. As an example, consider two employees of a supermarket, one who consistently worked a morning/early afternoon shift from 6:00 to 14:00 and the

other who worked an evening/overnight shift from 19:00 to 3:00. When associated location/date information for a standard 5-day work week is properly formatted and entered into a [Table of dates in locations](#), and a LATTE analysis is performed, results will indicate that these two employees overlapped on each of the five days. A more granular (i.e. hourly rather than daily) examination of their work schedules, however, would show that they were never actually working at the supermarket simultaneously. LATTE users should be mindful of this potential limitation when formatting data for a LATTE analysis and interpreting analytical results.

Training datasets

To help users develop familiarity with performing and interpreting output from a LATTE analysis, and to empirically elucidate some of the sensitivities and limitations of LATTE, one or more training datasets have been created. These training datasets can be downloaded from the [DTBE TB genotyping](#) webpage, which can be accessed by clicking on the [Help](#) (“?”) button in the LATTE online user interface (see [Figure 10](#)) or by using this [link](#).

Each training dataset includes one of each of the input files for an analysis populated with hypothetical data (e.g., a [Table of dates in locations](#) and [Table of infectious periods](#) for IP epi link analyses with date data, epi link analyses with date data, and Gantt chart analyses, [Table of grouped list\(s\) of people](#) and [Table of custom strengths](#) for epi link analyses without date data). Training dataset input files are formatted such that they can be uploaded without any modification to perform a LATTE analysis. As such, training datasets can be used most simply to confirm that LATTE is working properly and that users are uploading files and selecting analytic options/settings correctly. For example, by performing a LATTE analysis using the input files associated with [LATTE training dataset 01](#) and [LATTE training dataset 02](#), users can replicate all of the analytic outputs and associated screenshots presented in this user’s manual.

Training datasets can also be used to explore LATTE decision rules. For example, users can change the values of [Location start](#) or [Location End](#) or both associated with a particular value of [Location](#), or the values of [Confidence](#) associated with those dates, to see how these changes affect the scoring of IP epi link and epi links in LATTE IP epi link analyses with date data and epi link analyses with date data.

Contacts and additional resources

Users should direct all LATTE-related questions or comments to their DTBE point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a point of contact for LATTE analyses, to TBGenotyping@cdc.gov. Note that CDC technical assistance may not always be available for all user analyses and that the availability of these support services may be discontinued at any time.

Users can obtain LATTE supporting material from two webpages. The LATTE R source code is hosted on the [TB molecular epidemiology GitHub](#) webpage, which can be accessed by clicking on the [Help \(“?”\)](#) button in the LATTE online user interface (see [Figure 10](#)) or by using this [link](#). Running LATTE on a local (e.g., health department) computer gives users more flexibility to use personally identifiable information (e.g., names of cases, contacts, or locations) since input data are not transmitted to other computers or servers as part of a local analysis. The LATTE user’s manual, training presentation, input file templates, and training datasets are hosted on the [DTBE TB genotyping](#) webpage, which can also be accessed by clicking on the [Help \(“?”\)](#) button in the LATTE online user interface (see [Figure 10](#)) or by using this [link](#).

Citations

1. R Core Team (2017). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>.
2. National Tuberculosis Controllers Association and Centers for Disease Control and Prevention (CDC) (2005). Recommendations from the National Tuberculosis Controllers Association and CDC. Guidelines for the investigation of contacts of persons with infectious tuberculosis. MMWR Recommendations and reports. 54:1-47
3. Winglee et. al., Logically Inferred Tuberculosis Transmission (LITT): A Method to Integrate Whole Genome Sequencing, Clinical, and Epidemiologic Data to Identify and Rank Potential Tuberculosis Sources Cases (*manuscript in preparation*).

Acknowledgments

Online hosting of LATTE was made possible by staff of OAMD.

Funding for the development of LATTE and supporting documentation, and for training of state and county health department staff on use of LATTE, was provided by CDC.

Appendix 1 — Accessing the OAMD web portal

In general, LATTE users can be classified into one of four types depending on CDC employment status, CDC identification credentialing, and location of access:

User type 1: non-CDC users who do not have CDC Secure Access Management Services (SAMS) credentials

User type 2: non-CDC users who already have SAMS credentials (e.g., for TB GIMS)

User type 3: CDC users accessing from outside the CDC network

User type 4: CDC users accessing from within the CDC network

User type 1: non-CDC users who do not have SAMS credentials:

1. Non-CDC users will use non-CDC hardware (i.e. health department computer) to access the OAMD web portal via CDC's SAMS web portal. Access to the SAMS web portal requires credentialing. To initiate the SAMS credentialing process, users must send an email to dtbesupport@cdc.gov with the subject line “OAMD TB GIMS new user”; background information, problems, or questions related to the request can be detailed in the body of the email. Some non-CDC users will already have SAMS credentials as part of other work with CDC. Notably, non-CDC users with access to TB GIMS already have the SAMS credentials necessary to access LATTE and should consult the instructions for User type 2.
2. Users will receive an email invitation to register with SAMS from sams-no-reply@cdc.gov within approximately two business days. The email will have the subject line “U.S. Centers for Disease

Control: SAMS Partner Portal – Invitation to Register” and contain further instructions on how to complete the SAMS registration process. Additional information about the SAMS registration process can be obtained using this [link](#). Additional information about the SAMS identity verification process can be obtained using this [link](#).

3. Once SAMS credentialing is compete, users will need to have the OAMD web portal added to their approved list of accessible online CDC applications. To initiate this addition, users must send an email to their DTBE point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a point of contact for LATTE analyses, to TBGenotyping@cdc.gov, with the subject line “OAMD portal access request.” Background information, problems, or questions related to the request can be detailed in the body of the email. Users will be advised via email when the OAMD portal has been added to their approved list of accessible applications.
4. With SAMS credentialing complete and the OAMD web portal added to their approved list of accessible online CDC applications, users can begin the process of accessing LATTE by logging into the SAMS web portal via the SAMS login webpage ([Figure 78](#)) using this [link](#). Users will log in using the “SAMS Credentials” option on the left side of the login webpage. Users experiencing problems accessing the SAMS web portal via the SAMS login webpage should send an email to samshelp@cdc.gov to request assistance.

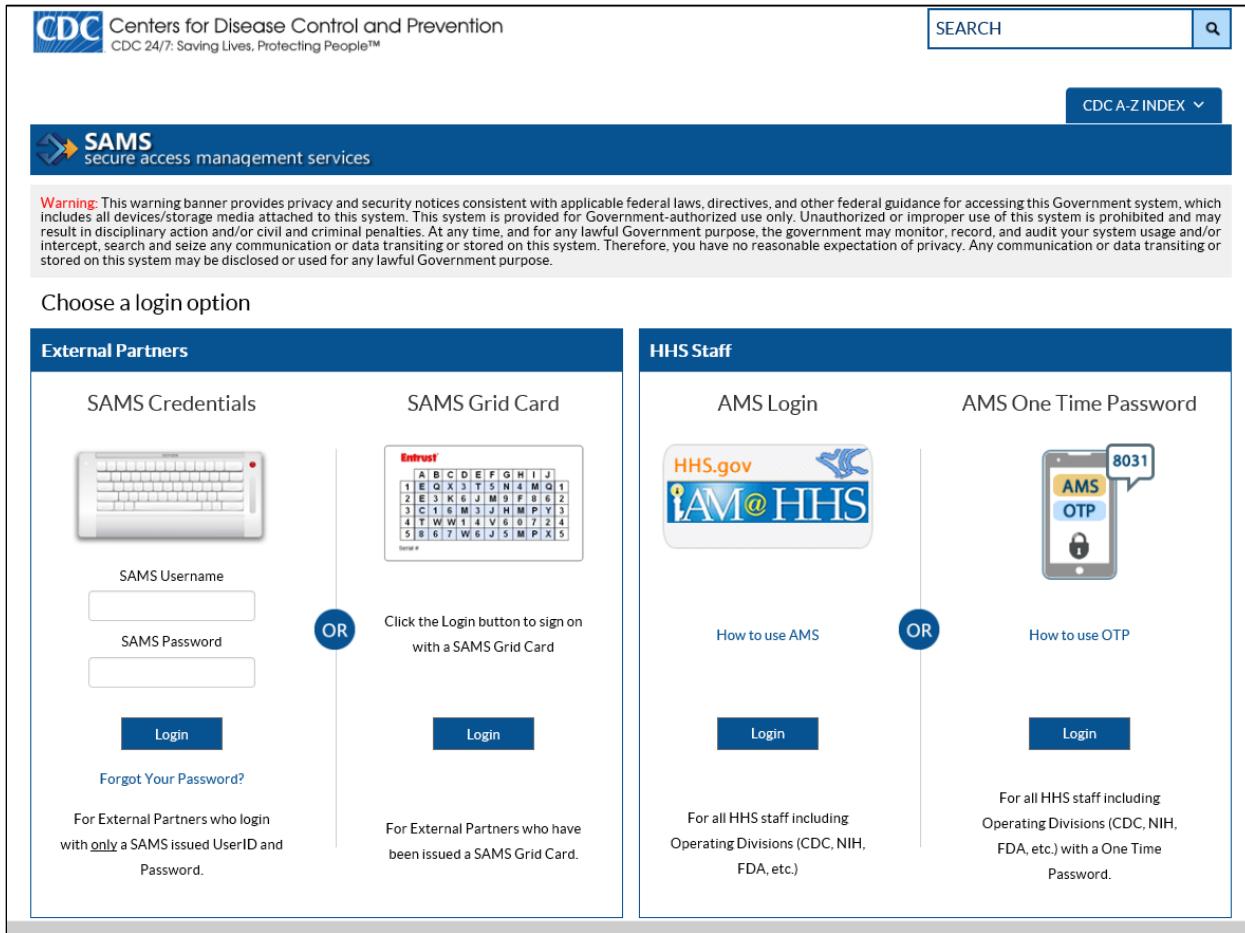


Figure 78. Screenshot of the login webpage for CDC’s Secure Access Management Service (SAMS) web portal.

5. After successfully logging into the SAMS web portal (*Figure 79*), users will see their approved list of accessible online CDC applications. The OAMD web portal should be listed as hyperlinked text reading “SciComp SAMS Portal” under the heading “OAMD Gateway” (A in *Figure 79*); click on this hyperlinked text to navigate to the OAMD web portal (*Figure 4*). If this hyperlink is not present or working properly, users should send an email to *TBGenotyping@cdc.gov* to request assistance.

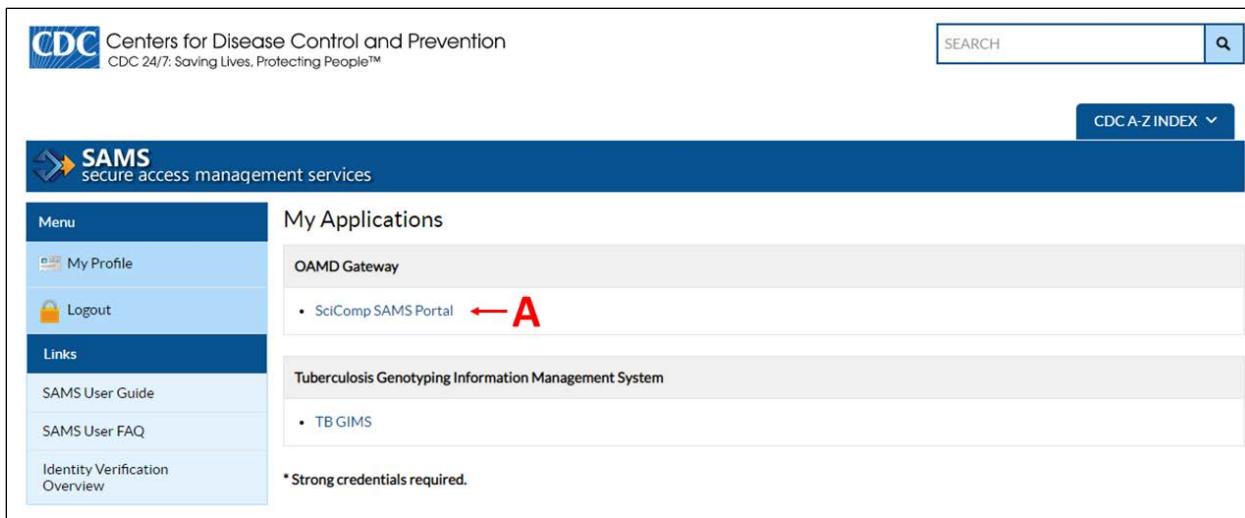


Figure 79. Annotated screenshot of the CDC’s Secure Access Management Service (SAMS) web portal. Annotation appears in red.

User type 2: non-CDC users who already have SAMS credentials (e.g., for TB GIMS):

1. Non-CDC users will use non-CDC hardware (i.e., health department computer) to access the OAMD web portal via CDC’s SAMS web portal. Access to the SAMS web portal requires credentialing. Some non-CDC users will already have SAMS credentials as part of other work with CDC. Notably, non-CDC users with access to TB GIMS already have the SAMS credentials necessary to access LATTE.
2. Users with SAMS credentials need to have the OAMD web portal added to their approved list of accessible online CDC applications. To initiate this addition, users must send an email to their DTBE point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a point of contact for LATTE analyses, to TBGenotyping@cdc.gov, with the subject line “OAMD portal access request.” Background information, problems, or questions related to the request can be detailed in the body of the email. Users will be advised via email when the OAMD portal has been added to their approved list of accessible applications.
3. With SAMS credentialing complete and the OAMD web portal added to their approved list of accessible online CDC applications, users can begin the process of accessing LATTE by following instructions in User type 1, Step 4 and in all subsequent steps.

User type 3: CDC users accessing the CDC network indirectly using VPN or CITGO

1. In order to remain compliant with terms of the National Tuberculosis Surveillance System Assurance of Confidentiality, CDC users must use CDC hardware (i.e., CDC laptop) to access LATTE; non-CDC hardware (e.g., health department computer or personal laptop, using a smart card reader) may not be used. Users will first need to be granted access to the OAMD web portal. To request this access, users must send an email to their DTBE point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a point of contact for LATTE analyses, to TBGenotyping@cdc.gov, with the subject line “OAMD portal access request.” Background information, problems, or questions related to the request can be detailed in the body of the email. Users will be advised via email when access to the OAMD portal has been granted. After receiving access, users will set up an OAMD web portal password (the user’s ID will be the same four characters of their CDC user ID).
2. Once access to the OAMD web portal has been granted and a password set, users can access LATTE by remotely logging into the CDC network via CDC Virtual Private Network (VPN) or via CDC Information Technology on the Go (CITGO). Details about how to remotely log into the CDC network via these methods can be obtained from the CDC Information Technology Services Office (ITSO) by phone (404-639-6000 in Atlanta, 1-888-647-3375 outside Atlanta) or email (ITSOServicedesk@cdc.gov). After successfully logging into the CDC network, users can access the OAMD login webpage (*Figure 80*) using this [link](#). Note that when using this option, only input files saved to a location on the CDC network (that has been remotely accessed) will be available for LATTE analyses; input files saved to the local computer will not be available. Users experiencing problems accessing the OAMD web portal via the OAMD login webpage should send an email to TBGenotyping@cdc.gov to request assistance.

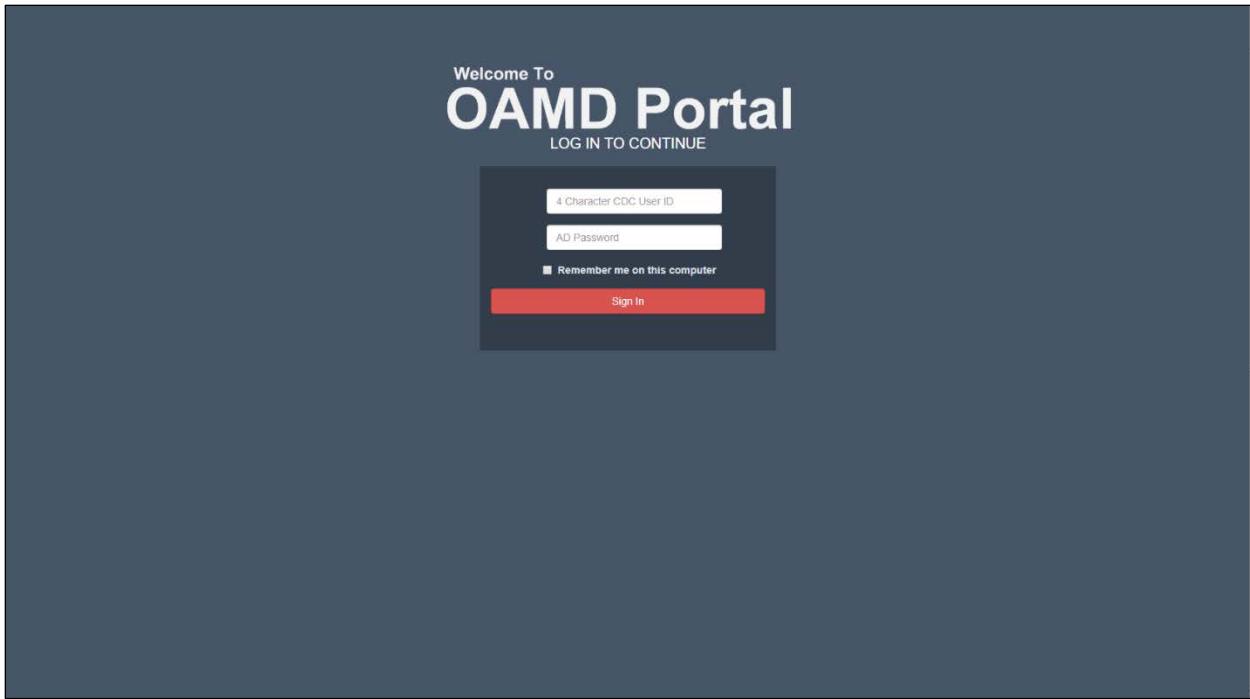


Figure 80. Screenshot of the login webpage for CDC's OAMD web portal.

3. After successfully logging into the OAMD login webpage (*Figure 80*) using their CDC user ID and password, users will be directed to the OAMD web portal (*Figure 4*).

User type 4: CDC users accessing the CDC network directly through physical connect in a CDC office

1. Users will first need to be granted access to the OAMD web portal. To request this access, users must send an email to their DTBE point of contact for LATTE analyses or, if they do not know who this person is or have not been assigned a point of contact for LATTE analyses, to TBGenotyping@cdc.gov, with the subject line “OAMD portal access request.” Background information, problems, or questions related to the request can be detailed in the body of the email. Users will be advised via email when access to the OAMD portal has been granted. After receiving access, users will set up an OAMD web portal password (the user’s ID will be their CDC user ID).
2. Once access to the OAMD web portal has been granted and a password set, users can access the OAMD web portal (*Figure 4*) using this [link](#). Users experiencing problems accessing the OAMD web portal via the OAMD login webpage should send an email to TBGenotyping@cdc.gov to request assistance.

3. After successfully logging into the OAMD login webpage (*Figure 80*) using their user CDC user ID and password, users will be directed to the OAMD web portal (*Figure 4*).

Note about internet browsers:

It is possible that on occasion users may experience difficulty logging into SAMS, the OAMD portal, or the TB molecular epidemiology webpage due to idiosyncrasies of their network connection or web browser. If problems are encountered users are encouraged to reboot their computer and attempt to log in using a different browser. LATTE seems to consistently perform with few if any issues when used in the Chrome web browser. If problems persist, users should take screenshots to illustrate the issue(s) they are encountering and attach these to an email sent to TBGenotyping@cdc.gov.

Appendix 2 — Assigning epi link strengths

While assigning values of **Strength of link** to epi links as part of a LATTE epi link analysis without date data is a subjective process (i.e., there is no single correct way to assign values), assignments should be made consistently across all epi links within a cluster in accordance with some system of formalized, user-defined rules, criteria, or definitions. As an example, the following system of **Strength of link** definitions was formalized by staff of multiple state and local TB control programs and CDC at a meeting of the Outbreak Detection Working Group on April 27, 2012:

1. “Definite” epi link:

- a. Two cases where at least one named the other as a contact.

or

- b. Two cases shared airspace at the same location (e.g., workplace, bar, shelter) at the same time.

2. “Probable” epi link:

- a. Two cases shared a common named contact but did not name each other as contacts.

or

- b. Two cases shared airspace at the same location (e.g., workplace, bar, shelter) during the same general time period, but the health department was unable to document that they were there at the same time.

or

- c. A person-search database (e.g., Accurint) or Internet search indicates the cases are relatives, associates, co-workers, or have shared a home address.

3. “Possible” epi link:

- a. Two cases lived or worked in the same neighborhood during the same general time period.

or

- b. Two cases shared activities or social/behavioral traits that increase the chances that they were in contact with each other (e.g., were experiencing homelessness at the same time and may have spent time in common locations for shelter or food).

or

- c. The two cases are connected on a social network site (e.g., are Facebook friends, are contacts on LinkedIn, one or both cases follow the other on Twitter).