eHealth Network

Towards a common approach for the use of anonymised and aggregated mobility data

for modelling the diffusion of COVID-19, and optimising the effectiveness of response measures:

Version 4.3

The eHealth Network is a voluntary network, set up under article 14 of Directive 2011/24/EU.
It provides a platform of Member States' competent authorities dealing with digital health.
The Joint Action supporting the eHealth Network (eHAction) provides scientific and technical support to the Network.

Adopted by consensus by the eHealth Network, Brussels, Belgium, on 30 June 2020

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I. THE ROLE OF MODELLING FOR COVID-19

I.1. Background

The Commission has published a Recommendation to develop a common EU approach for the use of mobile applications and anonymised and aggregated mobility data in response to the coronavirus pandemic[1]. The Recommendation sets out a process towards the adoption with the Member States of a toolbox, focusing on two dimensions:

- a pan-European coordinated approach for the use of mobile applications for empowering citizens to take effective and more targeted social distancing measures and for warning, preventing and contact tracing; and
- a common approach for modelling and predicting the evolution of the virus through anonymised and aggregated mobility data.

This document addresses the second dimension, namely, developing a common approach for modelling and predicting the evolution of the virus through anonymised and aggregated mobility data.

This document was adopted by consensus by the eHealth Network. The European Commission, the Joint Research Centre (JRC), the European Centre for Disease Prevention and Control (ECDC) contributed to this document. The Health Security Committee was been consulted on this document.

I.2. Epidemiological modelling

Mathematical modelling is routinely used for the evaluation of infectious disease dynamics and to plan and optimise public health interventions. A modelling approach can be used to:

- Predict/forecast the course of an epidemic;
- Plan resources allocation, for example providing projections on where and when critical conditions for countries or regions health sector may occur;
- Assess scenarios of implementation of countermeasures and propose effective control strategies (based on the impact of pharmaceutical and non-pharmaceutical interventions); design and analyse scenarios and assess exit strategies;
- Assess which interventions are needed to protect and shield vulnerable groups.

[1] https://eur-lex.europa.eu/eli/reco/2020/518/oj

One of the objectives of modelling activities using epidemiological surveillance is to precisely identify at national, regional and possibly even lower geographical extent, the transmission among individuals, characterised by the effective reproduction number (see below for definition).

R represents the expected number of cases directly generated by one case in a population where all individuals are susceptible to infection

$$R = \tau\ c\ d$$

Where τ is the probability of transmission, that can be influenced by the use of protective equipment, c is the contact rate among individuals and d is the duration of the infectious period.

The **basic reproduction number (R0)** measures the transmission potential of a disease. It is the average number of secondary infections produced by a typical case of an infection in a population where everyone is susceptible to infection. In practice, for new emerging pathogens, R0 is often estimated from the initial growth rate of outbreak (i.e. derived from the epidemiological curve, or contact tracing data).

When population immunity is enough to reject the hypothesis of full susceptibility, or when response measures are in place, then a second indicator is often used: the **time-dependent effective reproductive number** (**Rt**, sometimes Re, Reff). In practice that can be estimated from epidemiological curve based on date of onset or through more advanced statistical and mathematical models and useful for longitudinal follow-up in transmission trend.

In the context of this document, both entities are part of the classical modelling scope for the initial phase (R0) and in the follow-up of the emerging epidemic prone pathogens.

Furthermore, modelling provides a framework to quantify the impact of different sources of uncertainty. In order to be useful, epidemiological models must be ‘fitted’ to observed epidemiological data. In the early stages of an outbreak, simple models can be used to infer the characteristics of a virus e.g. the basic reproduction number and its transmissibility. As more cases occur, and more data becomes available, mathematical models could include the new acquired knowledge, this is termed ‘parameterisation’. Once a model has been parameterised and fitted, it can be used to simulate a range of different scenarios (e.g. what would happen if control measures were lifted next week?).

One challenge in epidemiological modelling is to choose a suitable model structure for the question in hand. In fact, the uncertainties associated with models can be high, in particular in the first phases of an emergency or in case of changes of the containment measures, because the relationship between epidemiological transmission and interventions are often non-linear and therefore small changes in some of the parameters may lead to large changes in the output results.

Model assumptions about whether to include an age structure to the population, whether certain behaviour varies between countries are often made. This is termed ‘structural uncertainty’. Any method that can allow to reduce the uncertainty and the variability of the results is beneficial to provide more consolidated responses. Comparing the output of several different models in a standardised way can illustrate the degree to which these assumption inform the model predictions.

The process of using multiple models to predict an outcome, either by using different training data sets or modelling algorithms/approaches is called “ensemble” model. Combining the output of several different models in an ensemble can lead to more robust estimates of final prediction than any one single model.

At the moment both the European Commission Joint Research Centre (JRC) and the European Centre for Disease Prevention and Control (ECDC) are conducting analyses to provide scenarios and identify the most important dynamics of the COVID-19 pandemic. However improvements of mathematical models are ongoing and therefore more detailed models are being developed that can provide further insights into the pandemic.

ECDC has developed a dynamic transmission model of COVID-19 to make forecasts of cases (by severity), deaths and requirements for hospital and, specifically, intensive care unit (ICU) beds for each Member State of the European Union (EU)/European Economic Area (EEA) and the United Kingdom (UK). The model is age structured and takes into account the history of control measures in each country. Assessment of de-escalation of interventions should take into account the ‘latest and reactive” epidemiological indicator in the epidemiological time series i.e. new admissions in intensive care units (or new hospitalisation).

ECDC strongly advocates for the formal comparison of models between institutions and research groups and their outputs. Thus it welcomes the opportunity to strengthen the collaboration with JRC in this regard.

ECDC is also in regular contact with a large, and growing, number of infectious disease modelling groups in the EU/EEA and the UK, both in public health institutions and in academia.

I.3. Anonymised and aggregated mobility data

I.3.1. Anonymised and aggregated mobility data to inform modelling for disease transmission and effectiveness of confinement measures

Anonymised and aggregated mobility data can be used to provide an indication of:

1. Number of aggregated movements between geographic areas which can help understand mobility patterns and quantify frequency of both short journeys in the local community and longer trips.
2. The level of connectivity between different geographic areas.

Anonymised and aggregated mobility data and indicators derived from them could serve as a proxy for frequency and proximity of contacts between individuals (not considering their infectiousness).

As such, it can be a helpful addition in the parameterisation and/or fitting of spatial meta-population models which simulate the transmission of a virus between spatial units.

Mobility indicators derived from anonymised and aggregated mobility data could be used to assess the effect of interventions that affect for instance short-distance travel (e.g. going to the shops vs. longer-distance travel, and consequences for economic activity, trade and tourism).

I.3.2. Anonymised and aggregated mobility data for modelling in the context of the COVID-19 pandemic

Anonymised and aggregated mobility data can be particularly useful to predict the spread of the COVID-19, monitor and evaluate the implementation and effectiveness of public health interventions and support effective delivery of medical services, food and other critical services. The usefulness of anonymised and aggregated mobility data has been proven in previous large epidemics such as the Cholera outbreak in Haiti in 2010 or the Ebola epidemic in West Africa in 2015, among others and more recently for COVID-19 in China.

Some Member States are increasingly interested in reaching agreements with mobile network operators to have access to anonymous and aggregated mobility data to help in the fight against COVID-19. For some Member States (e.g. Spain, Germany or Italy), these are voluntary agreements based on existing legislation and its interpretation. Other Member States have passed emergency legislation to provide for the legal basis of such transfers (e.g. Hungary, Slovakia). Many modelling groups in the EU/EEA and the UK are making use of anonymised and aggregated mobility and anonymised and aggregated social media data to inform spatial and transmission models. A full overview is currently not available.

The European Commission asked European mobile network operators across the EU to share voluntarily with the Commission aggregated and anonymised mobility data to deliver insights to help fight COVID-19. These data are being shared on the basis of an official letter signed by the Directors General of the Directorate-General for Communications Networks, Content and Technology (DG CNECT) and DG JRC sent to the Chief executive officers (CEOs) of the mobile network operators and on a pro-bono basis. The letter refers to Decision 1082/2013/EU of the European Parliament and of the Council on serious cross-border threats to health[2] where the Commission is obliged to ensure coordination and information exchange between the different mechanisms and structures whose activities are relevant for the preparedness and response planning, monitoring and combating serious cross-border threats to health.

The purposes for which these data have been requested are limited to:

- compare the spatial dynamics of the epidemics using historical matrices of mobility national and international flows;
- quantify the impact on mobility of physical distancing measures (travel limitations, non-essential activities closures, total lock-down etc.), including the phasing out of such measures as relevant;
- feed epidemiological models, contributing to the evaluation of the effects of physical distancing measures on the reduction of COVID-19 transmission rates in terms of reproduction number (i.e. expected number of secondary cases generated by one case);
- feed models to estimate the economic costs of the different interventions, as well as the impact of specific control measures on intra-EU cross border flows due to the epidemic.

The issues around the use of anonymised and aggregated mobility data by health authorities are related to the broader policy on Business-to-Government Data Sharing for which a High-level Expert Group has prepared a set of policy, legal and funding recommendations (in February 2020). In its European strategy for data, the Commission has committed to explore Business-to-Government Data Sharing as part of the Data Act foreseen for 2021.

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013D1082

I.4. Rationale for a common EU approach on epidemiological data, modelling practices and the use of anonymised and aggregated mobility data

Certain companies including mobile network operators and major technology platforms have published or made available to public authorities anonymised and aggregated mobility data. Such data is necessary for operational research on the COVID-19, modelling to understand how the virus will spread and modelling of the economic effects of the crisis.

In particular, the data will help to understand and model the spatial dynamics of the epidemic and to assess the impact of social distancing measures (travel limitations, non-essential activities closures, total lock-down etc.) on mobility. This is essential firstly to contain the spread of the virus and assess the needs notably in terms of Personal Protective Equipment and ICUs and, second, to support the exit strategy with data-driven models that indicate the potential effects of the relaxation of the social distancing measures. Effective cybersecurity and data security measures are essential to protect the availability, authenticity, integrity and confidentiality of data.

The current crisis has shown that public health authorities and research institutions would benefit from further access to essential information to analyse the transmission of the virus and to assess the effect of public health measures on mobility as a proxy of effectiveness on COVID-19 community transmission.

However, the EU's common efforts in combating the virus are hampered by the current fragmentation of approaches for data sharing. For instance, some aggregated epidemiological indicators (number of cases, deaths, hospitalised cases...) shared by Member States could be improved by format standardisation, for example when provided by Member States through various types of web applications (e.g. webpage, web service, dashboard, web map application).[3] The standardised data format of aggregated indicators outlined in this paper does not refer to existing reporting through systems such as The European Surveillance System (TESSy), but to web applications and dashboards developed voluntarily by Member States and is not part of reporting requirements according to EC 851/2004 and Decision 1082/2013/EU.

[3] To assess the impact of mobility data on outbreak dynamic, epidemiological data can be provided by surveillance data and in particular data generated by population-based surveillance systems or using hospitalisation rates as outcome. The latest indicators are less prone to selection bias due to different testing practices. ECDC receives case-based and aggregated data on COVID-19 cases directly from Members States surveillance systems using a common meta-dataset and reporting protocol, in accordance with the ECDC founding regulation (Regulation (EC) 851/2004) which states that EU Member States have to provide ECDC "the available scientific and technical data relevant to its mission", and Decision 1082/2013/EU, which provides the framework for epidemiological surveillance in the EU/EEA. COVID-19 data are collected through The European Surveillance System (TESSy), a database developed by ECDC in order to collect, analyse and disseminate surveillance data on infectious diseases in Europe. Standardised metadata have been agreed with Member States to facilitate reporting. Both detailed case-based data (currently focusing on hospitalised cases) and aggregated data (including weekly data on the number of cases, deaths, hospitalisations, ICU admissions and number of tests) are collected. Completeness for these data however varies. These reporting systems for COVID-19 have been developed and are coordinated jointly with WHO-Euro.

I.5. Objective and scope of this document

A common approach for:

1) the use of anonymised and aggregated mobility data in the context of the COVID-19 crisis that is necessary for

    a. modelling to map, assess and predict the diffusion of COVID-19 and the potential impact on needs in the health systems in Member States, such as, but not limited, to Intensive Care Units in Hospitals and Personal Protective Equipment; and

    b. assessing the effectiveness of interventions, including confinement (and de-confinement) through an assessment of changes in mobility pattern and derived indexes linked to social distancing. It would also help reflecting on the relative effects of local or regional "stay at home recommendations", other social distancing measures, or support any travel related recommendations (within a country and between countries) such as partial or full closure of borders.

2) how to use a common data format for openly sharing the limited set of aggregated and relevant epidemiological indicators currently published in Member States websites.

3) how modelling and predictions are built across the EU.

In developing this approach, Member States (represented in the eHealth Network, which will coordinate with the Health Security Committee, the Epidemiological Network the ECDC and, if necessary, the European Union Agency for Cybersecurity), should exchange best practices on the use of anonymised and aggregated mobility data, share and compare modelling and predictions of the diffusion of the virus, and monitor the impact of measures to limit its diffusion.

Various epidemiological outcomes can be modelled using mobility data. Some of such outcomes can be derived by data made available by Member States in a rapid fashion in their websites. This paper focusses on harmonisation of such epidemiological data. Other output data are provided by ECDC as part of its surveillance mandate and can be used for modelling, however they are outside the scope of this paper.

II. A COMMON APPROACH FOR THE USE OF ANONYMISED AND AGGREGATED MOBILITY DATA AND KEY EPIDEMIOLOGICAL INDICATORS FOR MODELLING THE DIFFUSION OF COVID-19, AND OPTIMISING THE EFFECTIVENESS OF RESPONSE MEASURES

II.1. Epidemiological data

One of the main challenges in the effort of monitoring and predicting the expected evolution of the COVID-19 pandemic is the harmonisation of epidemiological data and of information on the infection containment measures adopted by different Member States. ECDC has developed standardised case definitions and surveillance metadata for both case-based and aggregate reporting, however there are no standards describing how data should be published by Member States on national websites. Besides standardisation of data sharing, ECDC is establishing population-based surveillance of severe acute respiratory infection and is working with Member States to strengthen primary care surveillance of COVID-19, which would ultimately result in better data being generated at source. Indeed, all European Member States are collecting and sharing various data and indicators on the infection by COVID-19 and information about governmental countermeasures planned or adopted through public national websites. However, definitions used when presenting data on these websites may partially vary from country to country and different taxonomies (i.e. different indicator name for the same entity) are applied making comparison of data difficult. Public epidemiological data format is not fully comparable across Member States through their public website. Moreover, different data formats, together with the use of a variety of platforms, makes the automated data extraction challenging and significantly delays immediate use for timely analysis. To fully unlock the timely analysis and modelling opportunities, there is a need to work on common and comparable simple indicators list for key epidemiological data (see below), across Member States, as well as for mobility data at the same common geographical scale.

In particular, to effectively model the expected epidemic trend at European level, the collection, harmonisation and sharing of epidemiological data from national websites at subnational level should be encouraged.

A minimum set of COVID-19 related data could include

- number of cases (see case definition of ECDC[4]),
- fatalities,
- recovered cases,
- hospitalised cases (both current number and new admission of COVID-19 confirmed cases),
- COVID-19 confirmed cases in ICU(both current number and new admission of COVID-19 confirmed cases), and
- COVID-19 test performed per week.

Due to unstandardised format of web-data sharing issue highlighted above, a simple naming system and proposed exchange format regarding generic aggregated epidemiological data distributed through Member States could be used at EU level, thus converging towards standardised and simple datasets which will allow for faster and more effective monitoring of the spreading of COVID-19 across regions. Lessons-learned from this initiative could be useful in any future similar pandemic emergency. Appendix A shows the format of the data exchange that should be followed. This initiative should not affect or replace reporting of case-based and aggregated data through TESSy.

The minimum set of indicator is usually available through national website, but further harmonisation of the data format should be encouraged. In addition, the collection of data at the lowest possible granularity is also essential in order to be able to provide a coherent and detailed picture of the epidemic situation and performed relevant analysis with mobility information. Regional level geographical aggregation should be based on nomenclature of territorial units for statistics (NUTS) at NUTS 2 level, and if available preferably NUTS 3. For small countries where NUTS1, 2 and NUTS3 are similar, NUTS

[4] https://www.ecdc.europa.eu/en/covid-19/surveillance/case-definition

1 is sufficient. However, the requirements for anonymisation and aggregation must be strictly respected.

II.2. Anonymised and aggregated mobility data

Providers of electronic communications networks and services may contribute, on a voluntary basis, anonymised and aggregated mobility data to epidemiological modelling. In accordance with applicable laws, such contribution may be based on a law or on a public law contract with public authorities. Such laws or contracts must be compatible with Union and national law. Privacy and personal data protection laws, including on issues of anonymisation, are enforced by national competent and data protection authorities.

On 21 April, the European Data Protection Board (EDPB) published guidance on the anonymisation of mobility data. The EDPB emphasises that when it comes to using mobility data, preference should always be given to the processing of anonymised data rather than personal data.

II.2.1. Anonymising and aggregating data

Anonymisation refers to the use of a set of techniques in order to remove the ability to link the data with an identified or identifiable natural person against any "reasonable" effort. In line with the opinion of the EDPB, this "reasonability test" must take into account both objective aspects (time, technical means) and contextual elements that may vary case by case (rarity of a phenomenon including population density, nature and volume of data).

In case of doubt, those anonymising mobility data can evaluate the robustness of their process by assessing it against three criteria: singling-out (isolating an individual in a larger group based on the data); linkability (linking together two data points concerning the same individual); and inference (deducing, with significant probability, unknown information about an individual).

The following practices can be observed in the different Member States (the aim would not be to impose a common format due to the urgency of the crisis and different existing legislation in MS, but to map different approaches across countries and operators).

II.2.2. Using anonymous and aggregated mobility data for modelling: best practices/methodology

From anonymised and aggregated mobility data to indicators

Indicators on normalised movements or travelled distance, together with estimates of bilateral levels of connectivity between regions or territorial analysis products can be used in the following ways:

1. Feed models:

    a. Epidemiological models: i) contributing to the evaluation of the effects of containment measures on the reduction of COVID-19 disease spread in terms of reproduction number and ii) feeding meta-population models to forecast future outbreak propagations.

    b. Economic models: to estimate costs of the different interventions, as well as the impact of specific control measures on intra-EU cross border flows due to the epidemic.

2. Study the dynamics of the epidemic spread using historical mobility products.

3. Study mobility dynamics in response to containment measures, or the lifting of such measures.

What models should be used?

The use of anonymised and aggregated mobility data in compartmental epidemiologic models allows understanding of movements between compartments in a realistic and timely mode. In general, to describe the movements between different geographical compartments (i.e. regions or province or cities) statistical data is used, collected by the National Statistical offices. In this case it is possible to use real and timely collected data to build the transfer matrix between compartments.

The following can be used:

- Time series analysis for the assessment of the relationship between interventions and mobility changes

- Epidemiological studies, cross-over studies, and spatial analysis to derived spatial statistics and assess the changes mobility and the change of the outbreak dynamic at local level according to non-pharmaceutical interventions (for instance Bayesian model, Spatialised SEIR model, …)

- Advanced modelling notably better parametrisation of individual-based models.

What interpretation can be made during lockdown / when measures are relaxed?

Before the lockdown: the anonymised and aggregated mobility data allows to correctly infer the normal flows between geographical areas.

- During the lockdown: the anonymised and aggregated mobility data allows to estimate to which extent the mobility is reduced and thus allows to better forecast the lockdown propagation.

- During the lifting measures period: the anonymised and aggregated mobility data allows to understand how the society restarts its activity. From epidemiologic point of view, these data are not enough to judge the potential disease propagation because the use of masks and social distancing should strongly reduce the transmission rate respect to the prelockdown situation. However, such analysis can certainly provide with a relevant indications on the re-increase of population movement and social interaction.

Anonymised and aggregate mobility data can also be used for early warning, focused response and forecasting in case of new outbreaks and second waves of the pandemic.

The observed effect of major non-pharmaceutical interventions (e.g. stay-at-home enforcement or not, closure of public place, closure of educational institution(s)) on mobility can be performed, an infer effect of disease transmission outbreak dynamic. The comparison between “before, during, after” implementation is part of the analysis and would support assessment of the correlation with epidemic evolution and the quantification of effect of each type of interventions.

II.2.3. Time limitation and data retention

A time limitation for the data collaboration should be stated, including the data retention period for the anonymous and aggregated data. During crisis situations, data could be retained for no longer than 90 days or until the end of the crisis, whatever is the earlier date. This period can be extended if the crisis is still ongoing, based on an agreement with the mobile network operators. In any event, any remaining data should be deleted at the end of the crisis at the latest.

II.2.4. Safeguards, mitigation measures and security

When public health authorities reuse anonymised and aggregated mobility data for purposes related to the spread of the COVID-19 virus, several safeguards should be put in place to avoid risks of de-anonymisation, data leaks and damage to legitimate interests of mobile network operators.

First, public health authorities should put in place safeguards to avoid any risk of re-identification. Safeguards to be put in place to prevent de-anonymisation and avoid re-identifications of individuals and an assessment of re-identification risks should be carried out when correlating the anonymised data with other data.

Second, health authorities should have in place the appropriate technical and organisational security measures to minimise the risk of any unauthorised processing and access to the data.

Such measures should at least consist of ensuring that the data is appropriately encrypted when stored or transmitted, strong authentication mechanisms and strict access control policies and logging procedures are in place for the systems storing and processing this data. It has to be noted that national provisions stemming from the General Data Protection Regulation (GDPR) or the Directive on security of network and information systems (NIS Directive) may stipulate concrete technical requirements or other safeguards. Moreover, the security measures should also ensure that legitimate interests, of the mobile operators, notably commercially sensitive information such as trade secrets, are protected.

Thirdly, a number of mitigation measures should be considered to ensure the respect of the legitimate interests of the telecommunication operators. The data should only be used for a clearly defined set of purposes. Mobile network operators should not be held liable for the quality of the data in question or the use of the data by public authorities for public-interest purposes.

Finally, to address the potential limitations of private sector data, mobile network operators should offer reasonable and proportionate support to help assess the data quality for the stated purposes (e.g. method use for anonymisation and aggregation, type, accuracy, timeliness, format, representativeness).

II.2.5. Transparency

Such requests for reuse of private-sector data need to be transparent about the parties to the collaboration and their objectives. Regular coordination calls are encouraged to keep parties up-to-date on the progress of the initiative.

Public health authorities should inform the general public and stakeholders including civil society on broadly the type of data used and the results achieved. However, they should not disclose which specific data from what private entity/mobile network operators has been used for the different purposes. Companies can publicise their initiative, which will also contribute to its transparency.

Whenever relevant, public health authorities should ensure that mechanisms are in place to stimulate feedback and participation from the public and civil society, without compromising the confidentiality of the private sector data.

II.3. Modelling

COVID-19 is being modelled widely, both in the EU/EEA and UK and elsewhere using a wide range of approaches. Some models focus on the spatial aspects of transmission, others on forecasts of policy scenarios e.g. the potential impact of lifting intervention measures. As the epidemiological situation in Europe progresses, the structure of models may become more complex, allowing for the evaluation of more refined intervention scenarios. ECDC is in close contact with national modellers and research teams funded by the European Commission under Horizon 2020:

- MOOD: University of Southampton, Institut national de la santé et de la recherche médicale (INSERM), University of Hasselt, University of Oxford
- EPIPOSE: University of Hasselt, National Institute for Public Health and the Environment (RIVM), London School of Hygiene & Tropical Medicine, Institute for Scientific Interchange (ISI, Turin)
- ReCoVeR: INSERM, Insitut Pasteur
- And also those parties covered by the ECDC mathematical modelling framework contract: Universities of Bristol and Exeter, London School of Hygiene & Tropical Medicine, University of Hasselt, RIVM and Public Health England.

The network of modellers in public health institutions, and associated academics, is also being strengthened on an ongoing basis.

III. NEXT STEPS

- Member states with the Commission, in coordination with JRC, ECDC, and the Health Security Committee, will consider options to support the collection and sharing of coherent anonymised, aggregated epidemiological data at subnational level for modelling (for example, a minimum standardised set of data).

- Member States with the Commission will map different methods on data anonymisation and aggregation across countries and telecommunication operators.

- The Commission in coordination with JRC and ECDC will organise a dedicated workshop on modelling best practices and methodology for modelling of mobility data in the context of the COVID-19 crisis.

Annex A Proposed format to exchange epidemiological data

In order to exchange data about the ongoing outbreak of COVID-19, the harmonisation of the data format and content would support to the implementation of fully automatic procedures based digital machine readable formats and facilitate the sharing process. To illustrate the type of public websites maintained by Member States with aggregated indicators, a non-exhaustive list of national platform can be consulted:

- **COVID-19 related dashboard**:
  - Bulgaria: https://coronavirus.bg/arcgis/apps/opsdashboard/index.html#/ecacd239ee7e4fba956f7948f586af93
  - Cyprus: https://covid19.ucy.ac.cy/
  - Italy : https://www.arcgis.com/apps/opsdashboard/index.html#/b0c68bce2cce478eaac82fe38d4138b1
  - Latvia: https://spkc.maps.arcgis.com/apps/opsdashboard/index.html#/4469c1fb01ed43cea6f20743ee7d5939
  - Slovenia: https://www.arcgis.com/apps/opsdashboard/index.html#/1cf4f90e05984ae5a365f4838f746138
  - Sweden: https://experience.arcgis.com/experience/09f821667ce64bf7be6f9f87457ed9aa
- **Dashboard and download service or API**
  - Czechia: https://covid19.ucy.ac.cy/ and https://onemocneni-aktualne.mzcr.cz/api/v2/covid-19v
  - Denmark: https://www.ssi.dk/sygdomme-beredskab-og-forskning/sygdomsovervaagning/c/covid19-overvaagning
  - Latvia: https://data.gov.lv/dati/lv/dataset/covid-19-pa-adm-terit/resource/492931dd-0012-46d7-b415-76fe0ec7c216
  - Netherlands: https://www.rivm.nl/coronavirus-covid-19/grafieken
  - Slovakia: https://korona.gov.sk/koronavirus-na-slovensku-v-cislach/
  - Slovenia: https://www.gov.si/en/topics/coronavirus-disease-covid-19/actual-data/
- **Direct download CSV services**
  - Austria: https://info.gesundheitsministerium.at/dashboard_Hosp.html?l=en
  - Estonia: https://www.terviseamet.ee/et/koroonaviirus/avaandmed
  - France: https://www.data.gouv.fr/fr/datasets/donnees-hospitalieres-relatives-a-lepidemie-de-covid-19/
  - Malta : https://infogram.com/1p1xpwwgj1w3v2imxjzwjvv152b63z02dvv?live
- **National GitHub platform**
  - Norway: https://github.com/folkehelseinstituttet
  - Italy: https://github.com/pcm-dpc/COVID-19

The format adopted by the JRC to publish the data collected and published is very similar to the model designed by the Italian Civil Protection, as well as the mean adopted to distribute the files (in this case gitHub, for the simple reason that data are accessible by a simple URL; e.g. https://github.com/ec-jrc/COVID-19/blob/master/data-by-country/jrc-covid-19-countries-20200228.csv).

During the acute phase of the COVID-19 epidemic, the refresh of the information has been made on daily basis and is envisaged to evolve on weekly basis according to Member States decisions and according to epidemiological evolution.

The format required organises the data divided by regions, where this term refers to the administrative division of a country (e.g. ADMIN2, for Italy, regions). For the sake of simplicity, it is a CSV content, where

- Content is UTF-8 encoded;
- Fields are separated by commas (,).
- If commas are part of the data, the whole field appears between double-quotes (“);
- The first line contains the column headers;

- The National level and NUTS 2, version 2016 (and if available preferably NUTS 3);
- The aggregated indicators should preferably contains the entire daily time series to be able to account for retrospective correction and latest accurate information.
- To allow an automatic reading of the data at prefixed intervals, the file would be made available through machine readable format either through webpage/interface (CSV) (e.g. Belgium: https://epistat.wiv-isp.be/Covid/) or dedicated GitHub (e.g. Italy: https://github.com/pcm-dpc/COVID-19), or pushed to JRC repository specific webpage (link: https://webcritech.jrc.ec.europa.eu/jrc-covid-ingest).

The records are organised according to the following table:

Name	Description	Format	Example
Date	The day the data refers to date of last data resfresh.	YYYY-mm-dd or YYYY-mm-dd HH:MM:ss	2020-02-20 2020-04-08 12:00:00
Iso3	ISO 3166-1 alpha-3 code for the country.	AAA	ITA
CountryName	English name for the country.	Text	Italy
Region (NUTS 2 name if avalaible, or name of the corresponding geo-entity)	The name of the administrative division of the country.	Text	Piemonte
Code (NUTS 2 code)	The code of the administrative division of the country. NUTS code should be left blanc if the Region does not correspond to a NUTS2 or 3 level. In that case Lat & Lon should be included.	Text	ITC1
Lat (Optional if NUTS2 code is specified)	Latitude of the centre of the area representing the region (centroid).	Floating point number with at least 5 digits	45.060965
Lon (Optional if NUTS2 code is specified)	Longitude of the centre of the area representing the region (centroid).	Floating point number with at least 5 digits	7.926836
CumulativePositive	The sum of all confirmed COVID-19 cases since the beginning of the outbreak	Integer number	12924
CumulativePositiveTypeDate (Optional)	Metadata on type of date used for the CumulativePositive indicator	Text R: by date of report O: by date of onset of symaptoms	R or O
CumulativeDeceased	The sum of death from confirmed COVID-19 cases.	Integer number	1251
CumulativeRecovered	The sum of recovered from confirmed COVID-19 infection.	Integer number	1128
HospitalisedNew	The number of individual with confirmed COVID-19 infection admitted a medical institution	Integer number	3922
HospitalisedCurrent	The number of individuals with	Integer number	3922

	confirmed COVID-19 infection and currently under the cares of a medical institution		
IntensiveCareNew	The number of individuals with confirmed COVID-19 infection admitted in intensive care unit.	Integer number	438
IntensiveCareCurrent	The number of individuals with confirmed COVID-19 infection and currently in intensive care unit.	Integer number	438
TestNumberCumulative	Cumulative Number of test for COVID-19 diagnostic diagnosis (day or week)	Integer number	950