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MORBIDITY STATISTICS

2019 Pilot Data Collection
Belgium

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December 2019, Brussels, Belgium

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List of Abbreviations

BE	Belgium
EPS	Echantillon Permanent - Permanente Steekproef
EMR	Electronic Medical Record
EU	European Union
FPS	Federal Public Service
GAM	Generalised Additive Model
GP	General Practitioner
HDD	Hospital Discharge Data
ICPC	International Classification of Primary Care
IMA-AIM	InterMutualistisch Agentschap / Agence InterMutualiste
IVC-CSI	InformatieVeiligheidsComité / Comité de Sécurité de l'Information
MoH	Ministry of Health
MZG-RHM-MHD	Minimale ZiekenhuisGegevens / Résumé Hospitalier Minimum / Minimal Hospital Data
NHSD	National Hospital Stay Database
PH	Public Health
RIZIV-INAMI	RijksInstituut voor Ziekte- en InvaliditeitsVerzekering / Institut National d'Assurance Maladie-Invalidité
SGP	Sentinel Network of General Practitioners
TCT	Technische Cel / Cellule Technique

1. Introduction

Following the pilot studies on diagnosis-based morbidity statistics, executed in 16 Member States of the European Union (EU) between 2005 and 2011, a series of recommendations on the feasibility of a regular, periodic collection of diagnosis-based morbidity statistics was constructed by the designated Task Force. To examine these findings, Eurostat initiated the 3rd phase of the project and is currently cooperating with 10 EU Member States to identify the existing (national) systems and to evaluate the proposed methods in order to obtain the best possible national estimates for the (diagnosis-based) morbidity indicators, as included in the EU short list as a part of the report on *Morbidity Statistics in the EU*. During this phase, each participating Member State aims to obtain the best possible, nationally representative diagnosis-based morbidity statistic for each of the proposed indicators from the shortlist.

In Belgium, the current phase of the project is being conducted within the Service Lifestyle and Chronic Diseases at the Department of Epidemiology and Public Health of Sciensano, the Belgian institute for health. Sciensano's mission is to provide support for public health policy, national coordination and international representation through scientific research, expert advice and evidence-based reports. Based on independent scientific research, Sciensano formulates evidence-based recommendations and solutions in order to proactively aid to develop national policies regarding public health in Belgium. Sciensano also aims to coordinate health related activities across the country, the communities and regions to facilitate the availability of uniform, qualitative health information to support these recommendations and to aid shaping the health related policies.

The coordination of the current phase of the project was carried out by a senior scientist within the Health Indicators team of the Lifestyle and Chronic Diseases unit. Additionally, a junior scientist was recruited to perform the data collection and analysis in order to obtain the requested estimates of the diagnosis-based morbidity indicators. Other senior members of the scientific staff within the same unit, as well as the head of the unit, were involved in the project to consult on current and previously performed work.

In order to obtain the best possible estimates for the diagnosed-based morbidity indicators, Sciensano set out five objectives within the project, where the goal was to:

- Construct a suitable administrative infrastructure to collect the diagnosis-based morbidity data in a sustainable way. The infrastructure is intended to facilitate and simplify future work and possible related projects by maintaining the necessary

supporting documents, the code generated for the performed analyses, the contacts with important stakeholders and to maintain permissions regarding data that were obtained during the project.

- Collect the required diagnosed-based morbidity data according to the EU shortlist of indicators within the reference period of [2014, 2015, 2016] as is the major goal of this project.
- Identify the major restrictions in obtaining the best estimate for each indicator. By doing so, recommendations regarding the future development of the project and data collections can be appropriately constructed. Additionally, any glaring flaws in the existing data collection and available data sources in Belgium, as well as possible opportunities that can be exploited, can also be identified, which can greatly improve future data collections and developments in other projects at Sciensano.
- Develop suitable methodologies to estimate each indicator, based on the acquired diagnosed-based morbidity data. The development of these methodologies can be considered as an integral part of the aforementioned infrastructure that was set up during the project. These methodologies are intended to simplify future work and related projects and enhance the reproducibility by focussing on the correctness, simplification and documentation of the used methods.
- Develop potential solutions to counteract and correct for the identified major restrictions. As the capabilities of the main used sources to generate a best possible national estimate of an indicator, are often limited in one way or another, suitable corrections should be identified and developed to enhance the quality of the output data.

Within the scope of these objectives, each process and required procedure is documented for internal use and to support future work. This report will summarize and bundle such documentations in order to create an overview of the progress and current state of the project.

The report is divided into 6 chapters, each focussed on a specific topic, relevant to the pilot data collection. In section 0

Procedures and Methods, the applied processes and strategies are clarified, especially regarding the collaborations with the stakeholders of the project in Belgium. The strategy regarding the data source selection is also further clarified here. Subsequently, in section 3, Development and Successes, the most important breakthroughs in the project are indicated, signalling the obtained progress and the current state of affairs regarding data access, analysis and results. Section 2, Encountered Difficulties, however, further elaborates on the difficulties faced while executing the pilot data collection. The main areas where these complications were found, were the data access, the definitions used by the data sources and the Eurostat guidelines and their (in)compliance and the data quality in general. Then, in section 3, Intermediary Conclusions, some final thoughts and recommendations regarding the various successes and difficulties are formulated. Lastly, in section 0,

Future Work, the planned activities and the roadmap of the project are explained.

Furthermore, as is indicated in the roadmap of the project in section 0,

Future Work, the project is situated around its halfway point after 9 months, after its initiation in April 2019. This interim report is therefore also situated to report the state of affairs of the pilot data collection in Belgium 9 months after the initiation of the project. The final report, which should be used to report on the finalised state of the project is to be submitted after 18 months, which translates to September 2020 for Belgium.

2. Procedures and Methods

2.1. STAKEHOLDERS INVOLVED

The project required the involvement of multiple stakeholders in Belgium who, each in their own way, make unique contributions to the outcomes and results of the tasks and performed work. In Table 1, a comprehensive overview of the most relevant organisations, related to this project, can be found, along with their respective role, indicating their (in)direct influence and how the stakeholder has impacted the activities. Subsequently, the possible contributions and limitations are listed per stakeholder, each indicating the potential strengths (possible contributions) and weaknesses (possible limitations) regarding the involved party. These factors respectively point out the opportunities for each stakeholder, thus indicates where their role is strengthened and how they can actively contribute, and the threats, which indicate to possible damaging factors in the relation between each stakeholder and the projects. The threats are to be considered with great caution as they can substantially limit the validity of the resulting outcomes. Finally, a strategy to maintain the best possible relations between the stakeholders and the project, while making optimal use of the contributing factors and to inhibit the possible limitations of each stakeholder, was developed and incorporated in each activity. A general description of these strategies was then also included in this table.

Table 1 Overview of the Stakeholders within the project.

Stakeholder	Role	Possible contributions	Possible limitations	Strategy
Sciensano	Data analysis & Reporting	* Deliver diagnosis-based morbidity statistics. * Create internal framework & infrastructure for collection of diagnosis-based morbidity statistics. * Establish new collaborative relations.	* Inability to process the received data into deliverable estimates.	* Weekly meet-ups to discuss encountered difficulties & progress. * Documentation of decisions, actions & analyses.
Intermutualistic Agency (IMA)	Data Provider	* Deliver insurance based data. * Verification of results.	* Delay data access. * Inability to provide requested data.	* Establish project collaboration. * Maintain relation & contact to discuss progress or problems.
Intego Network of General Practitioners	Data Provider	* Deliver primary care based data. * Verification of results.	* Delay data access. * Inability to provide requested data.	* Establish project collaboration. * Maintain relation & contact to discuss progress or problems.

National Institute for Health and Disabiliy Insurance (RIZIV-INAMI)	Data Provider	* Deliver hospital based data. * Provide coding of diseases & health care services.	* Delay data access. * Inability to provide requested data.	* Establish project collaboration. * Maintain relation & contact to discuss progress or problems.
IVC-CSI	Data Protection	* Facilitate data request and access permission.	* Not willing to approve data access. * Delay data access.	* Obtain fully justified data requests.
Eurostat	Project Client & Sponsor	* Facilitate project * Facilitate meetings among participating countries. * Provide project grant	* Cut grant * Prioritize other projects	* Participate in meetings. * Maintain contact to discuss updates. * Provide reports.
Federal Public Service on Health, Food Chain Safety & Environment	Government	* Facilitation of hospital data in cooperation with RIZIV-INAMI	* Prioritize other projects	* Establish project collaboration.

2.2. COLLABORATIONS

Apart from setting up and maintaining the required relations to the relevant stakeholders regarding the project and exchanging contact details, specific collaborations were established to allow the acquisition of data and to facilitate the project. Additionally, some of these collaborations were initiated so that a novel cooperation between Sciensano and the respective third parties was allowed, which leads to enhanced future data exchanges and collaborations within other projects. The experiences while setting up these collaborations and novel data exchanges from this project will also prove useful for further use within Sciensano. Specific collaborations with external parties are described below.

2.2.1. Intego Network of General Practitioners

Intego is an integrated network of General Practitioners (GPs) in Flanders, which is the biggest region in Belgium (BE) population-wise and accounts for 60% of the BE population, led by the Academic Centre for General Medicine from KU Leuven, which aims to create a large database to centralise morbidity data in primary care. The network incorporates an automated data collection, based on the Electronic Medical Record (EMR) of the patient as registered in their GP's practice. The collection of such EMR data allows the network to convey the incidence and prevalence of a multitude of (primarily GP, non-specialist care requiring) diseases, as well as data concerning diagnostic tests or applied therapies in the registered GP practices.

The Intego network of GPs was identified to be the main useable source to be able to deliver the diagnosis-based morbidity data in the primary care in Belgium. Therefore, a collaboration between Intego and Sciensano was initiated to establish the access to the required micro-data

in the Intego database. Doing so enabled the determination of the estimates of the GP-based morbidity indicators of the shortlist. Currently, this collaboration is project based and thus will end when the project is finished, however, both parties have indicated to be willing to engage again into more collaborations in the future. It should also be noted that the collaboration refers to a specific scientist at Sciensano due to data protection regulations. Therefore, if the access of multiple scientists is required, multiple collaborative requests have to be initiated in order to be able to establish a full collaboration between all scientists at Sciensano and Intego.

It should be noted however that the data from the Intego Network has several limitations regarding the capabilities to produce a national estimate. Firstly, the geographical limitation, as only GP practices in the region of Flanders are included in the network. Therefore, any regional differences between the Flemish Region, the Brussels Capital Region and the Walloon Region cannot be extrapolated and should thus be determined from a different source (if relevant). Secondly, the network only covers about 2% of the Flemish population. Thus, to produce a national estimate, the prevalence and incidence as calculated from the Intego Network data, should be upscaled in order to obtain the actual prevalent/incident cases in Belgium (while accounting for regional differences when deemed necessary). Thirdly, the diagnoses are coded using the ICPC classification and are, in parallel, mapped using the software thesaurus to ICD-10. However, this mapping is not completely reliable and validated for accuracy as of yet. Therefore, the ICPC coding system was used to obtain the matching diagnoses for each indicator, even though the ICPC & ICD-10 definitions do not match completely. Also, as the registration in the EMR is not episode based, it can prove tricky to calculate the prevalence for some indicators, depending on the nature and the need to visit the GP during the episode and/or follow-up. It is also unknown how representative the Intego Network of GPs is regarding the GPs in Flanders. Lastly, it is unknown how exhaustive the GP's information on the patient is, when reliance on external sources is desired or necessary (for instance after hospital admission for a specific condition or medical imaging examinations). This may cause some underestimations when the GP is not aware or has no recording of a certain (externally defined) diagnoses. For instance in Belgium, it is not uncommon for a patient to go directly to a dermatologist or gynaecologist, without referral from a GP.

2.2.2. IMA-AIM

The InterMutualistisch Agentschap – Agence InterMutualiste – InterMutualistic Agency (IMA) governs and analyses an exhaustive collection of health care data, as processed by the health insurance services in Belgium and aims to support the improvement of the performance, the quality and the accessibility of the Belgian Health Care system and health/invalidity insurance. IMA-AIM also facilitates the Permanent Sample (abbreviated as: Echantillon Permanente

Steekproef – EPS), which contains a 1/40 randomly sampled cohort of health insured individuals in Belgium for whom their data regarding health insurance, which is compulsory in BE, is collected over time, allowing to perform observations on an individual level. This cohort is considered to be a representative sample of the whole of the Belgian population (including the three main regions) and was thus identified as the preferred data source to collect the insurance-based morbidity data. The database consists of three types of data, one regarding the population, one containing a database with reimbursed health care procedures and one with the reimbursed medication.

A collaboration between IMA-AIM and Sciensano for the use of the EPS data has been well established in the past and could thus be exploited further, after approval by the technical department of IMA-AIM, to initiate the data access for the scientists at Sciensano that are working on the Morbidity Statistics pilot data collection.

The operational case definition was based on the reimbursed drug prescriptions as a proxy for the disease, corresponding to the definitions as provided by Eurostat. This method however was handled with caution, as using such proxy diagnosis can easily lead to a wrong conclusion. For example, patients not taking the drugs but who do have the disease nonetheless are not identified as a patient when using this approach, which could lead to an underestimation of the indicator. Contrarily, patients taking the drugs for other reasons than the disease of interest (e.g. in the context of drug repositioning) should be excluded as these would lead to an overestimation using such identification approach. To exclude these non-cases, a threshold value to determine a real case is based on the predefined number of Defined Daily Doses (DDDs) per year for each disease.

2.2.3. RIZIV-INAMI

In order to acquire the Hospital Discharge Data (HDD – referred to as Minimale ZiekenhuisGegevens, MZG or Minimal Hospital Data, MHD), the Federal Public Service of Health, Food Chain Safety and Environment (also named the Ministry of Health – MoH) was contacted. The MHD is a registration by the MoH whereby the (anonymised) administrative, medical and nursing data of the (non-psychiatric) hospitals is collected to support the governance and health policies of the MoH and the hospital (networks). However, after initial communication with the MoH, it was clear that the dataset does not allow follow-up of patients over multiple years, which makes it impossible to distinguish incident cases from prevalent cases, and between hospitals. The latter can prove particularly tricky, as in Belgium, the patients have the right to choose their own caregiver and are thus not bound to go to 1 particular hospital. This would lead to a misclassification of an incident case when a patient

would, for example, visit a second hospital for follow-up, rather than continuing his/her care in the same hospital. To solve this problem, it was proposed to use the National Hospital Stay Database (NHSD) rather than the MHD.

The NHSD is a merged dataset, which is based on:

- The MHD from the MoH, which contains information concerning the diagnoses and procedures for each admission.
- The Hospital Billing Data (HBD) from the National Health Insurance companies, which contains the information regarding the billing data for hospitalized patients. This data was sent by the hospitals to the health insurance companies for reimbursement.

The primary goal of this dataset, which is created by the TCT (Technische Cel – Cellule Technique) from RIZIV/INAMI, is to generate a comprehensive overview on the required care, the financial needs and the reimbursed costs, for each specific pathology and to be able to list these costs for each hospital individually and compare the data between all Belgian hospitals. Additionally, by combining the MHD and the HBD, it is possible to create a linkage between the patient and the received care over multiple years and between multiple hospitals. Therefore, the NHSD was preferred over the MZG to deliver the required information on the HDD.

Since there have been no previous official data exchanges of the NHSD yet, a new collaboration between the TCT of RIZIV and Sciensano was set up to enable access to the required data. The use of the NHSD database is considered to be advantageous for both current and future projects within Sciensano as this database contains valuable epidemiological data, which can be used to strengthen findings and evidence based policies. Both parties have promptly expressed their interest and enthusiasm regarding such cooperation, where the TCT would deliver the data if Sciensano would perform the data analysis. However, as this collaboration is novel and requires the necessary permissions from the governing committees regarding data privacy, acquiring these permissions to set up the data exchange has proven to be a difficult and cumbersome process. It should be noted that, with the necessary permissions acquired, not only is the data exchange within the scope of this pilot data collection permitted, but future data exchanges should be permitted as well. Additionally, once the initial permissions are acquired, obtaining future permissions should prove less cumbersome, which will simplify routine data requests.

2.3. DATA SOURCE SELECTION

The data source selection builds further on the findings from the two previous phases in the Morbidity Statistics project while accounting for the definitions and requests within the current phase of the project.

It should be noted however, that no additional new (useable) data sources were identified at the start of this phase when compared to the previous phases, while some data sources that were included in the previously proposed list of data sources were deemed to be not appropriate within the framework of the specific objectives and current definitions.

The data sources, as used in the pilot data collection, can essentially be divided into four categories of morbidity data, based on their basic composition and origin, allowing to cover most of the required health care areas to account for the requested diagnosis-based morbidity data:

- Specific registers
- Primary care data
- Hospital discharge data
- Health insurance data

Unfortunately, as was also concluded in the second phase of the Morbidity Statistics project, there is still no system in place to routinely link these types of data sources at an individual level in Belgium. As some kind of workaround, the aggregated data from e.g. the Cause of Death Registry can be added to the Hospital discharge data to account for deaths before arrival in the hospital, but routine linkages between sources is not yet available. Through the morbidity statistics project, multiple discussions among the various stakeholders have been held to start developing such initiative. However, even though most parties agree on the added scientific value, most are hesitant regarding the practical implementation. Reasons for this are mainly related to financial doubts and privacy regulations, because such a system could easily become expensive to implement and maintain, while the validity regarding the current privacy regulations is doubtful. To get the permissions to initiate and operate such a system will most likely prove difficult without the creation of a legal framework. Therefore, new in-house meetings have been set up to start thinking about the practical implementation and the necessities of to start up and maintain such a system. Also, by developing a more global vision, the benefits for all involved stakeholders can be clearly set out. These discussions should lead to a more constructive initiation of the system and a possible practical roadmap to develop a national health information system.

2.3.1. Selection of the Best Sources

To obtain the final data sources for the pilot data collection, first, the information and conclusions as proposed in the second phase of the Morbidity Statistics project were used and evaluated to check if these data sources are still compliant to the proposed definitions. To do so, the concept notes, where the data source is evaluated in function of each disease, from the second phase of the project were used. The selection of the sources was as follows:

1. If the proposed data source from the second phase was still compliant to current definitions and considered to be the best available source to provide the best possible national estimate of the indicator, then the data source is kept as the primary data source for the pilot data collection.
2. If the proposed data source from the second phase is unable to comply to the current definitions or if the proposed data source is unable to produce the best possible estimate of the indicator, then the data source is replaced by an alternative source for the pilot data collection.
3. If there was no proposed data source, a data source was proposed to be able to produce a national estimate for the indicator.

The evaluation and proposal of alternative/new data sources was conducted similarly to the evaluation in the second phase of the Morbidity Statistics project using the following criterions:

1. Is the source based on medical diagnoses or a proxy diagnoses (e.g. the use of prescription medication)?
2. Is the source exhaustive or sample-based?
3. If the source is sample-based, is the sample population well defined and representative?
4. Does the source capture all cases? Or in the case of a sample, is the source exhaustive for the covered population?
5. Is the coverage regional or national?
6. If the source is regional, how can the regional differences be accounted for (if existing)?
7. Does the source allow the computation of annual figures?

The complete list containing the indicators and their respective sources, as used in the pilot data collection, can be found in the table in Appendix A on page 38.

3. Development and Successes

3.1. ACQUIRED DATA

As mentioned before, to acquire the necessary diagnosis-based morbidity data, new collaborations were set up and existing partnerships were further exploited. The acquired data is individual-based and was pseudonymised by the data source organisation or a Thrusted Third Party (TTP) facilitating the data access. This allows to precisely calculate the desired indicators following the proposed definitions, rather than making use of (previously reported) aggregated data. The four main diagnosis-based data types, as mentioned in Section 2.3 Data Source Selection, are discussed below.

3.1.1. Primary Care Data

As was mentioned while discussing the collaborations set up for this project, the main data source used for the primary care data is the Intego Network. This data is based on the EMR registration and thus includes the following important information:

1. Basic patient attributes
    a. Gender
    b. Date of birth
    c. District of GP
    d. Yearly Contact Group[1] (YCG)
2. Diagnosis
    a. Start of Diagnosis
    b. End of Diagnosis
    c. ICPC Code
    d. ICD-10 Code

The patient attributional variables allow to calculate the indicators, broken down by gender and age (which is calculated using the date of birth). It is not possible to break down the data between residence status as only people with a social security number are registered (and are thus by definition only residents). The diagnosis variables then allow to specify the diagnosis by ICPC-2 classification, as the software is based on ICPC classification coding of the diagnoses and the mapping from the software thesaurus to ICD-10 has proven to be suboptimal. This does cause some compatibility issues regarding the definitions as proposed in the shortlist of indicators, however, the used ICPC codes were the codes as proposed in the shortlist as an alternative for the ICD-10 definition of the indicators. The start of the diagnosis is essential to determine if a case is either an incident case or not, while the end of the

[1] The YCG is the number of patients who visited their GP during the year of reference

diagnosis can be used to exclude cases with past episodes (for a non-chronic disease) when calculating the prevalence. The calculation of the incidence by person and incidence by episode is thus rather straightforward, as the exact onset of the diagnosis is included in the record.

The calculation of the prevalence, however, is not as straightforward, as the registration in the EMR does not record the primary incentive for each visit, which thus makes it impossible to clarify whether a visit to the GP is linked to the previously diagnosed disease or not. Therefore, the calculation of the prevalence should be based on the Yearly Contact Group (YCG) or the Practice Population (PP). Although, in Belgium, the patient is free to choose their GP, often, it is opted that a patient can register their Global Medical Dossier (GMD) with a GP of their choosing. Usually, the patient will then visit this GP most regularly as then, the GP will have the best (medical) knowledge of the patient. The YCG translates then to the patients who contacted their GP at least once in that year. Therefore, all patients who contacted their GP in 2016 will be indicated as YCG = 2016. There are however patients who do not visit their GP during that year. To account for these non-visits, the Practice Population (PP) can be calculated. The PP is the estimated total of patients of each GP practice, whether they visited their GP during that year or not and is calculated using the YCG and a correction factor to account for the fraction of non-visiting patients (corrected for gender, age and district). The PP was preferred over the YCG for the calculation of the prevalence as the PP was deemed more representative of the Belgian population. Using the PP, the prevalence of the indicators could eventually be calculated by counting all cases from the PP who visited the GP in the reference period who were once diagnosed with the disease. However, the results based on this calculation should be treated with caution as not every indicator is suitable to use this method to calculate the prevalence.

3.1.2. Insurance-Based Prescription Data

The EPS from IMA contains information as registered by the health insurance services in Belgium and thus allows to calculate the indicators based on reimbursed insurance-based (prescription) data. An extensive use of prescribed medication intake can be used, using the ATC coded medication as a proxy for the disease. There were basically two types of definitions of the diagnosis possible:
A predefined pseudo-diagnosis as created by an expert group, appointed by IMA & RIZIV
A custom created pseudo-diagnosis

By default, the EPS provides predefined pseudo-diagnoses, defined by a working group set up at RIZIV/INAMI, as a collection of ATC codes with a DDD threshold, which can be used directly from their EPS database. By doing so, the incidence and prevalence can be calculated

easily. Should the case definition not match any predefined pseudo-diagnoses or should there be no pseudo-diagnoses defined, users can create their own case definitions using the ATC codes and DDDs using a sub-file (Pharmanet) of the database. In either case, the proxy for the diagnosis can be calculated using the provided ATC codes from the proposed definition. Additionally, the data can be broken down by gender, age (calculated from birth year) and official residence, which is determined by the domicile region of the person and is thus not an exact match of the residence definition as proposed in the guidelines.

The prevalence was then determined by counting the number of people corresponding to the DDD threshold as set in the EPS within the reference period. The incidence (by person) was then estimated by counting only the cases which had such medication use in the reference year, but not in the preceding two years of the reference period.

3.1.3. Hospital In-/Outpatients

Due to the novel cooperation between the TCT from RIZIV and Sciensano, the data regarding Hospital In-/Outpatients from the NHSD was not yet available at the time of writing. The permission to obtain access to the database is under consideration and awaits a Small Cell Risk Analysis (SCRA) to assess the identification risk. Once this SCRA has been approved, the permission will be granted.

3.1.4. Register Data

As there are no specific registers containing diagnosis-based data regarding the proposed indicators, no national registers could be used within the pilot data collection.

3.2. ANALYSIS INFRASTRUCTURE

One of the key objectives of the project is to set up the required infrastructure to support the data access, collection, analysis and organisation, while facilitating future work.

3.2.1. Used Software

The standard office tools were used for basic organisational tasks like generating reports, spreadsheets, documentation files, planning, … The files that were used, were documented and created in such a way that future use of the tools is as easy as possible.

For the collection and analysis of the data, the main used software was SAS and R. The access to some of the data sources is facilitated by a TTP, which requires an active licence of SAS. Therefore, to extract the data from these sources, reusable and well-documented SAS programs were written. Once the data are obtained, the analysis was performed using R. Again, the used code was written to be as easy to read as possible with a focus on ease of

use and reproducibility of the results, so that, no matter who would use the program, would obtain the same results without having to interfere too much in the code. To do so, the R shiny package was used. Therefore, to analyse the data, the researcher can use a shiny web application to explore the data, call a visualisation and generate the output for the selected indicators, without having to change the code. For the analysis, the mgcv package was used to generate a Generalised Additive Model (GAM) of the prevalence/incidence data. Using such a model allows to approach the binary state of an individual (case vs non-case) through a binomial probability distribution and smooth the data, while accounting for the given variables as gender, residence, age.

3.2.2. Analysis Methods

To increase homogeneity of the results and to streamline the analysis, the same approach was used to analyse the data for all data sources. This approach consists of three steps:

Select the relevant data in the dataset

1. Firstly, only the data regarding the reference period was selected from the database to exclude non-relevant data.
2. Secondly, the cases of interest were selected using the classification system of the data source (ATC, ICPC, ICD-10) and the corresponding criteria.

Calculate the indicator

- A target variable (y) based on the definition of the prevalence or incidence was created, where the following is true:
    - Target variable for prevalence: y = 1 if the patient is considered a case in either of the years within the reference period. Otherwise: y = 0.
    - Target variable for incidence: y = 1 if the patient is considered a case only in the reference year. Otherwise: y = 0.
    - Table 2 can be considered to aid the understanding of the target variable.
- To account for extreme deviations in the data, an estimation GAM model based on a function in the form of: y ~ Age + Gender + Residence, was generated. This model provides data smoothing and is able to break down the data to the desired category, with respect to the total population.

Upscale the calculated indicators to the Belgian population

1. The total number of cases in Belgium was calculated using the mid-year population data of the reference year (2016) as the reference population.
2. The upscaling of the estimated indicator was performed by each corresponding category, broken down by age, gender and residence.

Table 2 Truth table containing the definitions of when the case can be considered as a prevalent case or incident case, based on the case status in the reference period [T-2, T] with T = 2016.

Case in 2014	Case in 2015	Case in 2016	Prevalent case	Incident case
0	0	0	0	0
0	0	1	1	1
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

1.1.1. Tools & Software Development

As mentioned before, some tools were developed to increase the reproducibility of the analysis and to decrease the risk of errors due to miscoding or the collection of variables. First, to facilitate the data collection, which required in most cases the use of SAS, reusable SAS macros were written to ensure a homogenous information collection among the indicators and future extractions. By doing so, the researchers working on the data collection have a clear view on the necessary variables, which are required to perform the analysis, and can be certain that the data collection includes the same variables each time it is performed.

To perform the analysis, it was opted to develop an application using R to assist the researcher to analyse the data and to enable the user to explore the data without having to code. By doing so, and effectively separating the user & development aspects of the analysis, the risk of coding errors due to necessary changes is reduced. This application is intended for in-house use only, with only the researchers working on the project being able to access the app. Therefore, it was possible to include the data exploration aspect as this function shows the actual microdata from the source. A screenshot of the application in use can be found in Figure 1, which shows the interface and the possible graphical output based on the data and the model. Using the interface, the researcher can indicate whether or not to show the source or model data (the latter including the variables used in the model and the target variable), which indicator is used (prevalence/incidence) and for which disease the indicator is calculated. When this selection is performed, a graphical representation of the source data and the indicator estimation can be shown (as shown in the Figure 1) and the output data, which matches the guidelines format, can be generated.

Along with the comments and descriptions, provided in the code, tutorials and user manuals were crafted to aid future iterations of the project and related assignments using similar analysis techniques and data. This will provide especially useful in communicating the applied analysis and data extraction techniques as most of the data that was received was obtained in a novel way and had to be explored before exploiting these datasets. During future iterations

and related projects, when data should be extracted from the same sources, these tutorials can be used to shorten the time, necessary to apply for access to the data and the data exploration. These tools are an integral part of the infrastructure that was set up to complete the pilot data collection.

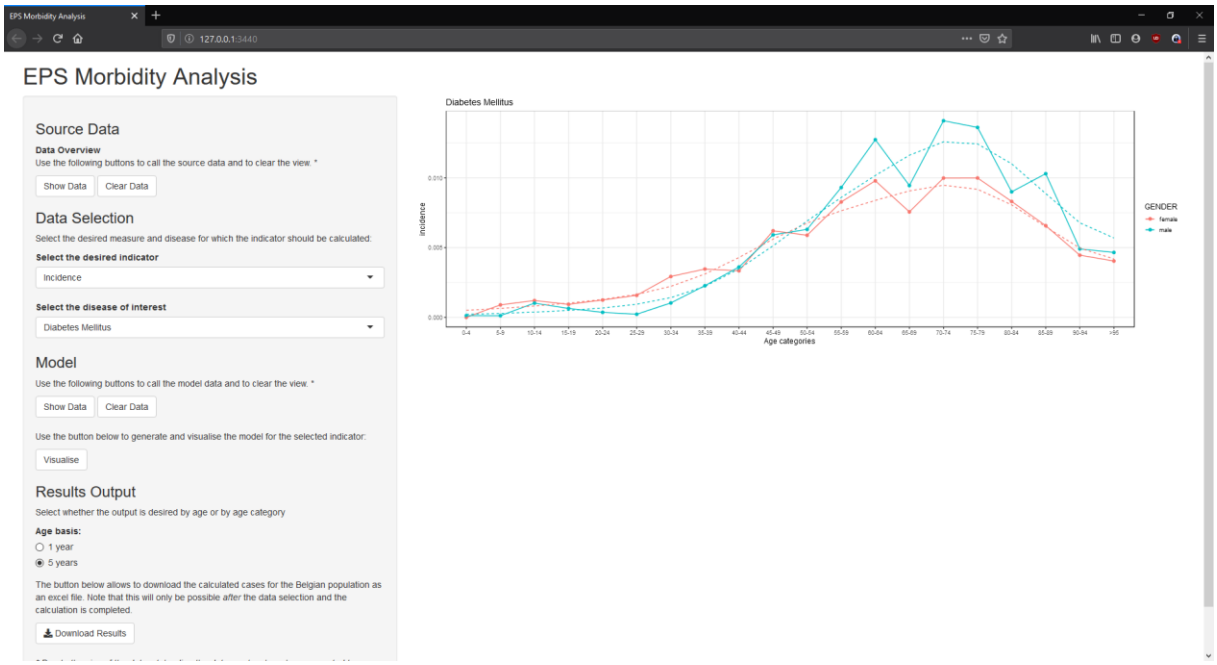


Figure 1 Screenshot of the application used to analyse the EPS data. On the left, multiple fields can be recognised where the user can indicate the desired actions (e.g. show the source data, model the data, create a visual representation and generate the output data)

1.2. PRELIMINARY RESULTS

The available data, as described in section 3.1, was analysed and some preliminary results were calculated for the insurance-based and primary care based morbidity indicators. The results of these calculations can be found in the additional Excel data file *"BE_MORB_DATA_TEMP"*, which is attached to this file, along with the complementary Excel metadata file *"BE_MORB_METADATA_TEMP"*.

It should be noted that, as was indicated in the Excel data file, these results are all estimations as none of the, as of yet available, data sources is exhaustive for the whole of the Belgian population.

2. Encountered Difficulties

2.1. AQCUIRING DATA ACCESS

Due to privacy regulations, acquiring access to the microdata from various sources has proven difficult and a cumbersome process. The reason being that, within the context of specific research projects, the use of pseudonymised individual (personal) data can only be authorised after a complex procedure of investigating the security risks of each dataset and having received positive advice from the Information Security Committee. Additionally, to comply to the privacy regulations, the patients should be aware of the information that is being processed (by the means of a clause or personal contact, of which the latter would not be possible in this case), or a legal framework should allow such processing. The latter is applicable to the EPS, where access is granted structurally after initial request by the Sciensano researchers.

The confidentiality of the data was considered with great care. For most of the sources, a remote access system was used to grant access to the data, rather than making the (encrypted) dataset directly available for analysis. By doing so, data leaks are supposedly avoided. However, as each data source uses their own (proprietary) system, creating a linkage between the data from one source to another is not possible. Therefore, organising a linkage between the datasets is, for the time being, also not considered to be feasible, unless a legal framework is developed and such linkage can be granted by law.

Regardless of the great care regarding the privacy protection and the confidentiality measures that are in place, the access was severely limited and permissions were obtained with considerable delay. Consequently, efforts were made to ensure a smooth cooperation between Sciensano and the data sources in order to facilitate routine data collections in the future without having to reiterate the data requests yearly.

2.2. DEFINITION AND DATA COMPLIANCE

Difficulties were also encountered regarding the proposed definitions in the guidelines and the possibilities within the available data. There were basically two types of discrepancies possible, regarding the compliance towards either the indicators or the population, as discussed below.

2.2.1. Indicator Definitions and Code Mappings

The case definitions as proposed for the indicators are based on the ICD-10 classification system, however this classification is not always available in the used sources.

The Intego GP Network uses the ICPC classification, where the GP can indicate a disease case, based on a selected set of definitions in a thesaurus for each diagnosis. Therefore, the underlying concept can be different or a slight mismatch to the definitions as used in the ICD classification. The proposed ICPC codes from the shortlist were used where possible.

The EPS dataset is based on the proxy definition of the diagnosis, characterised by the ATC classification. Where possible, the proposed ATC definition from the shortlist is used. However, by using this classification, some mismatch in the estimation might arise as there might be identifiable cases not using the medication for the listed ICD-10 defined disease due to e.g. drug repositioning. An example of this might be obese patients using diabetes related medication (categorised as ATC A10) for the purpose of weight control.

The NHSD used the ICD-9 classification prior to 2015 and has adopted the ICD-10 classification since. Caution is advised when interpreting the results prior to and after the transition between the classification systems as the use of the different classifications might yield a difference in results due to mismatching between the systems. Where applicable, the ICD-9 proposed definitions were used for the data prior to 2015 and the ICD-10 proposed definitions were applied to the data after the transition.

2.2.2. Population Definitions and Available Data

Other discrepancies were found in the definitions regarding the case populations and the respective available information in the datasets. More specifically, the exact definition of residence and thus the distinction between residents and non-residents, as was proposed in the guidelines could not be applied within the context of the used data sources.

The Intego GP network dataset only registers patients with a Belgian Social Security Number and only indicates the district of the GP practice where these patients are registered. Therefore, no information is available on non-residents. The estimated population of non-residents, treated by the GPs attached to the network, is considered to be less than 1% of the total treated population.

In the EPS dataset, the residence of the patient is determined based on where the patient has his/her domicile registered. It is therefore possible to see regional differences within Belgium for a certain disease, which would enable the EPS data to serve as a regional correction if the EPS was not considered as the primary source. Additionally, non-residents can be identified by having a foreign domicile. This is however not completely compliant to the proposed definition as these non-residents could include people living in Belgium for more than 12

months, but still having their official address in a foreign country. On the other hand, patients, with their official address in Belgium, living for more than 12 months abroad, who return for medical care to Belgium, would then be seen as residents. This is however the only possibility to include the residence of the patient into the statistics for this dataset.

2.3. DATA QUALITY

The quality of the data is considered to be somewhat variable due to a number of issues. These issues are can be divided into three main categories concerning the accuracy, the completeness and the coverage of the data, which are defined in sections 2.3.1 to 2.3.3. In Appendix A, where the overview of each indicator and its preferred source is listed, a quality indication is also included. Here, one can recognise five quality levels, grouped into three colours:

A. Good quality, which means the data source is considered to deliver qualitative diagnosis-based morbidity data. Indicated in green in the table.
B. Good coverage & completeness, which indicates good data quality regarding the coverage and completeness of the data while some issues are present regarding the definitions and/or methods used. Also indicated in green in the table.
C. Doubtful coverage, completeness & methods. There are issues identified regarding the completeness of the cases and coverage of the population in the data, in addition to the issues named in quality level 2. Improvements are deemed necessary to be able to generate a representative national estimate. Indicated in yellow in the table.
D. Doubtful quality. There are diagnostic data available, however, the data quality is evaluated so that the data are considered to be very divergent from the Eurostat definition. Other sources should be considered to report data on this topic. Indicated in red in the table.
E. No data available. No diagnostic data could be provided for these indicators. Indicated in grey in the table.

These quality levels try to comprise the different aspects of the quality categories as discussed below to indicate whether the data can be used for official statistics or whether there is room for improvements.

2.3.1. Coverage of the Population

The first important qualitative aspect of the data which can be evaluated, is the coverage of the data, in order to inspect how well the population is represented in the dataset.

The NHSD is a national database, which thus includes all hospitalised cases in Belgium and is regarded to be quasi-exhaustive for the residential population. As the data was not yet received, the coverage regarding the non-resident population is not yet clear.

The EPS database is a random sample, consisting of a 1/40th sample of the Belgian insured population, which is 99% of the residents. This data source can thus be regarded as a national representative of the Belgian population. The non-resident population is also covered in this database, as they are indicated using a unique code, which makes it possible to account for non-residents. As the database is based on a sample, the total number of cases has to be calculated. Therefore, it should be noted that the obtained results for the indicators, are estimations.

The Intego network contains only the information of GP practices, in Flanders, who voluntarily joined the network. Therefore, merely 2% of the population within the region of Flanders is covered, which can hardly be considered as a representative sample for the Belgian population due to the regional differences. However, using regional corrections, based on nationally representative sources like the EPS, the limited coverage can be accounted for. Furthermore, non-residents are not registered, as the data collection is based on the EMR of the patient, which needs a Belgian social security number for identification. Analogously to the EPS database, due to the limited coverage, the total number of cases in Belgium need to be calculated and are thus also an estimation.

2.3.2. Completeness of the Cases

The second qualitative aspect of the data considered, was the completeness of the cases regarding the indicators. None of the sources are considered to be exhaustive regarding all of the cases of a given disease, with the exception of a few indicators requiring specific conditions.

The NHSD is a national database, which includes data from all hospitals in Belgium and can thus be considered to be exhaustive regarding the hospitalisation information. However, cases that do not require hospitalisation are missed, which would lead to a severe underestimation when using the NSHD for diagnoses that do not always require admission to hospital.

The EPS database contains information regarding medication use as a proxy for the diagnosis, rather than the actual diagnosis itself. However, the relation between the medication and diagnosis is often not sensitive enough to include all diagnosed cases (e.g. patients not taking the medication for treatment, using alternative therapies,…), thus generating false negatives. Also, the specificity should be so that patients, who were not diagnosed with the disease of

interest, but are taking the proposed proxy medication, are not included, thereby avoiding false positives.

Regarding the Intego network, in Belgium, the GP has no gate-keeper function. Therefore, patients who directly seek specialist care could be missed if not properly communicated to the GP. The information could also be missing if the external information is not stored or recorded by the GP within the EMR. Additionally, the completeness of the data depends on how the EMR is used by the GP, as the collected information is based on routine data, and it is unknown how detailed and how far all diagnoses are recorded.

2.3.3. Accuracy

The third and last aspect of the data quality considered was the accuracy or the correctness of the data regarding the information obtained from the indicators.

The accuracy of the NHSD data might be affected by the primary purpose of the data collection, which was financial rather than epidemiological, as the diagnoses are registered as part of the administrative system of the hospitals.

The EPS database, being based on health insurance data, is also based on administrative data and could thereby suffer from the same accuracy problem as the NHSD. Additionally, fraudulent use of preferential reimbursements can deter the accuracy as, in this case, the person whom received the prescription is not the person who actually takes the medication.

The accuracy of the data from the Intego network database is relatively unknown and depends on a number of factors. First, the data is based on the routine data, as it was registered by the GP with the clinical purpose of case management. Consequently, the quality of this data may vary by GP and could be insufficient due to lack of time or interest. As mentioned before, it is also unknown to what extent external diagnoses (e.g. from specialist care or lab results) are recorded by the GP. Lastly, as the data is case management-based, it is not always possible to identify a visit to the GP as a follow-up visit for a given condition or for a different disease.

3. Intermediary Conclusions

3.1. THE NEED FOR A NATIONAL HEALTH INFORMATION SYSTEM

As was mentioned before, no routine data linking between various sources is performed. Consequently, the results for each indicator rely on the data as delivered by the most relevant source. Due to the shortcomings of each data source, it can be argued that by relying on one source to detect the prevalence or incidence of a given condition, too many cases are potentially missed. Therefore, while discussing the project with the various stakeholders, the development of a National Health Information System was proposed repeatedly.

Such a national HIS could be the basis to create a combined database, which would be invaluable to multiple epidemiological projects. However, even though most of the stakeholders have expressed a certain enthusiasm regarding such HIS and agree that such a HIS would enable a deeper understanding of the public health status, none of the stakeholders seemed to be willing to start with the development of such a system. Key pitfalls seem to be issues regarding the financing of such a system along with the privacy regulations and imposed risks of combining multiple datasets. Discussions at Sciensano have started to further investigate the possibilities of such a HIS and the possible solutions to the aforementioned issues.

3.2. THE NEED FOR NATIONALLY REPRESENTATIVE PRIMARY CARE DATA

Difficulties have been encountered, as explained in section 2, regarding the lack of availability of nationally representative primary care (diagnosis-based) data, as there is no system in place which allows to collect such data. Currently, in Belgium, multiple GP networks exist, however, using the data, collected by these networks is not straightforward due to the following reasons (among others) :

- Not every GP or practice is willing to share the data of their patients as they are cautious about the privacy and do not want to void their medical confidentiality. Especially in the event of a data breach.
- Patients could object the idea of their data being shared to a network or governmental institute.
- Different software systems are used by the different GPs and practices, complicating a unified case definition, especially if different coding practices are used.
- Not every network collects the data routinely.
- The registration of the data is non-uniform on different software platforms, as some systems are more appropriate to track patients over time than other platforms.

- GP networks are often founded focussing on delivering continuous patient care or for financial reasons, not for epidemiological purposes.

Most of these problems could be solved if there was a unified system in place that allowed the use of data, based on the EMR of the Belgian GPs. To date, such a system does not exist yet. However, with the implementation of a national health information system, as mentioned in section 3.1, a system which collects nationally representative primary care based data on a routine basis could be developed and included.

3.3. CONCLUSIONS REGARDING THE SET OF INDICATORS

Some concerns regarding the set of indicators were expressed during the execution of the pilot data collection. Many of these issues can be traced back to the definitions linked to these indicators and will be discussed in a different section (Section 3.4).

The added value of some proposed indicators is questioned, especially in the context of collecting diagnosis-based morbidity data. The validity of some indicators in the proposed list is questioned as these indicators are not considered a medical diagnosis, but rather a cause of a given condition. These indicators are:

- P8: The results, obtained by analysing the prevalence/incidence of Parkinson's disease, should be analysed with caution as a difference exists between Parkinsonism and Parkinson's disease. Treatments exist to reduce the Parkinson-like symptoms that are not part of Parkinson's disease, but are initiated due to a different mechanism of action. These Parkinson-like symptoms are defined as Parkinsonism and can be mistakenly diagnosed as Parkinson's disease, especially using proxy diagnoses.
- P20, P21 & P23: The differentiation between asthma and COPD is not always straightforward, even for the physician diagnosing the patient. Therefore, even when using diagnosis-based morbidity data, caution should be exercised when interpreting these results. Understanding the evolution of these important chronic diseases, however, is tremendously important to initiate adept policies regarding the treatment.
- PB36 & PB37: Although there are ICD-10 codes to indicate a land transport accident, due to the nature of the data (which administrative, primarily focussed on the financial aspects of secondary care), a primary focus on the given care might exist. This leads to the inclusion of the codes regarding fractured bones or other traumas rather than indicating an accident took place. Further examination of the dataset is needed to examine these concerns.

- PB38 & PB39: Similar concerns to PB36 & PB37 are expressed, as a fall might cause a diagnosis of trauma, which would be most likely to be included in the diagnosis, rather than the fall itself.
- PB40 & PB41: The indicator could experience the same problems as the aforementioned indicators in this list. Additionally, the definition of the indicator is rather broad, as the indicator includes anything between suicidal attempts, intentionally inflicting cuts or intentional self-poisoning. This could lead to a significantly varying case definition depending on the sources available to investigate the indicator, leading to vastly different results among the member states. This would render the indicator virtually unusable for (inter)national comparisons.
- PB42 & PB43: The same concerns regarding the broad spectrum of possible case definitions could be made, as the indicator could include anything between a minimal allergic reaction to antibiotics to major complications during surgery leading to the death of the patient. The ambiguity found within the indicator leads to a potentially unusable indicator.

3.4. CONCLUSIONS REGARDING THE DEFINITIONS USED

As discussed before, the data is unable to comply to some of the proposed definitions. Specific issues were mentioned regarding the proposed definitions of residence. Some of the consulted sources determine the residence of the patient based on their domicile address, not on their length of stay in Belgium. Some sources even have no case definition for non-residents and are thus not capable of registering non-residents by default. As a result of this, regardless of the fact that it would be possible to register residence duration using administrative data sources, such as health insurance data, the resulting indicators are limited to the available case definitions and the residence is divergent from the proposed case definition. Therefore, the added value of the continuous use of the currently proposed definition of residence is questioned.

Most of the consulted data sources also rely on different disease classification systems, such as ATC and ICPC-2, therefore also creating a (slight) diversion from the case definitions. However, where possible, the proposed alternative disease classification codes by Eurostat were used. Consequently, the results still comply to the, albeit secondary, proposed definition. Though concerns are expressed regarding the compatibility and description of some of the proposed definitions, such as:

- P19: The ICPC-2 code (R81) is not completely matched to the original proposed ICD-10 definition (J12-J18).

- P22 & P23: Identical ICPC-2 codes are used. Therefore, identical results will be produced based on this definition, while the original ICD-10 proposed definition would imply (slightly) dissimilar results.
- P24 – P25: As discussed in the previous phase of the Morbidity Statistics project, there is no possibility to differentiate the alcoholic and non-alcoholic liver diseases in primary care (both are D97 coded). Therefore, only the pooled results can be precisely determined. Measures to estimate the proportion of alcoholic and non-alcoholic based liver diseases are being thought of, but no guarantee exists these estimations will be able to generate precise estimations.

Therefore, the use of the currently proposed definitions of these indicators is questioned.

3.5. DATA QUALITY EVALUATION

Due to the varying quality of the data regarding representativeness at a national level, completeness of the cases, compliance to the Eurostat definitions, … a comprehensive, yet concise quality evaluation method should be applied. This will create a clear overview of the data quality as Belgium will be able to finally deliver to Eurostat. Additionally, as a lot of heterogeneity is expected in the quality of the data as delivered by the different member states, it could be useful to use an easy to read scoring system to evaluate the quality and comparability of the different indicators across the member states.

The researchers at Sciensano would therefore propose to use a colour-based evaluation system as used in Belgium to evaluate the data quality, which consists of:

- **Green**: The data is of good quality with respect to the three criteria: good completeness, good coverage of the population and good accuracy. Or the data has a good coverage of the population and a good completeness of the cases and is thus nationally representative, while some issues are identified regarding the methods and/or case definitions. e.g. The residence in the data source is defined differently then as was proposed in the Eurostat guidelines.
- **Yellow**: The quality of the data can be considered as doubtful. There are issues identified regarding either the coverage of the population or the completeness of the case, thereby making the source, without corrections, not nationally representative. Alternatively, if large issues regarding the methods and/or definitions are identified, this level is applicable as well.
- **Red**: The data quality is considered to be poor. The definitions and/ methods used by the data source are too divergent to be compliant to the Eurostat proposed indicators. Other data sources should be proposed to deliver a reliable nationally representative estimate.

- **Grey**: No diagnosis-based morbidity data is available on the indicator.

Using these four colour codes creates an easy to read, yet clearly defined, quality evaluation, which can be used to easily compare the delivered data in a summarising table. Such comparison could be made as such:

Country	Indicator 1	Indicator 2	Indicator 3		…	Indicator i
Country A						
Country B						
Country C						
Country D						
…						
Country j						

This system could be used in the end evaluation of the project to assess the necessary improvements for each member state and potential changes from the pilot data collection to the actual implementation of the morbidity statistics in all member states.

4. Future Work

4.1. PLANNED ACTIVITIES

As the project is not yet finished, the following activities are planned to be carried out in the coming months.

4.1.1. Analysis of the NHSD

Once the permission to access the NHSD has been granted, the analysis will be performed. This analysis is expected to be similar to the analysis of the insurance-based EPS data (the variables have already been communicated) and should not take too long. The only problem that might prove difficult is the data size. However, during analysis, several optimisation measures were already taken into account to lower the computational burden when calculating the estimates.

4.1.2. Corrections of Not Nationally Representative Data

As mentioned before, the data from the Intego network of GP practices is limited to Flanders and, as was shown before, there are significant differences in the prevalence of certain diseases among the different regions in Belgium. Therefore, when relying on data, based on only one of these regions, corrections should be applied to calculate a representative national estimate.

The results, based on non-national data, can be corrected by taking into account the prevalence/incidence ratios between the regions from different (possibly non-diagnostic-based) sources. These sources can be for example the Belgian Health Interview Survey (self-reported data source) or the EPS database, where the medication consumption can be used to show the difference between the regions, but would be inadequate to calculate a best estimation of the indicator.

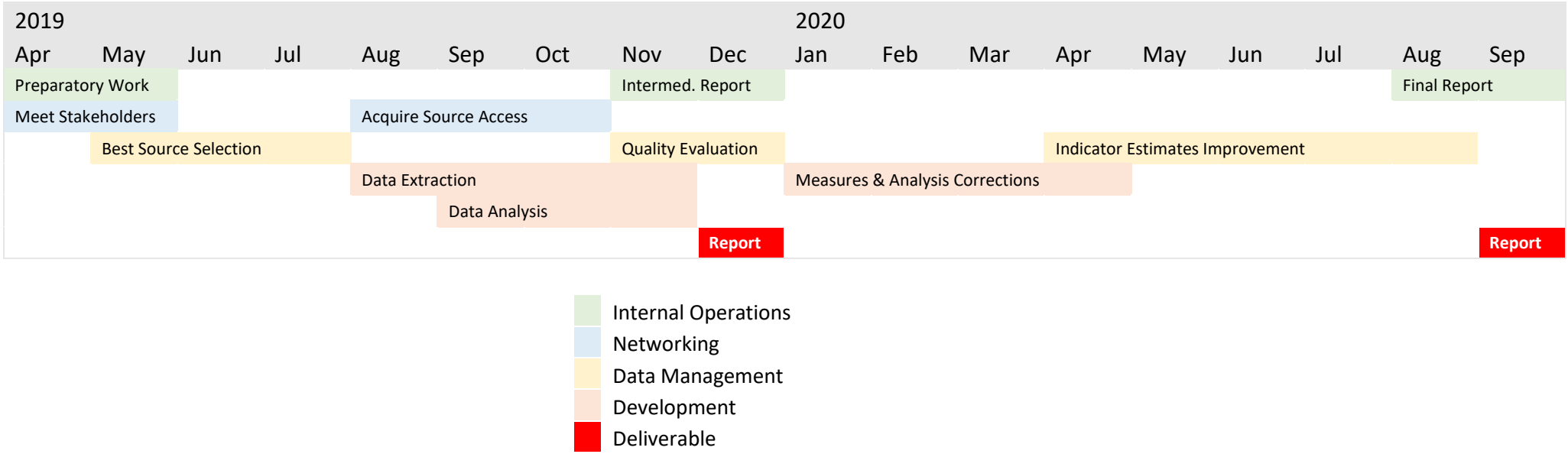
4.1.3. Corrections Regarding Non-Optimal Definitions Matching

In some cases, due to the use of different disease classification systems or different operational definitions, there might be a discrepancy between the requested definition and the definition of the calculated indicator. Where possible, these differences are to be investigated whether correction is possible and, if so, how these corrections can be performed.

4.2. PROJECT ROADMAP

Figure 2 shows an overview of the roadmap of the project. Here, one can see the planned activities and the remaining time as well as the performed work, which has been described in this report.

Figure 2 Roadmap of the project



Acknowledgements

The project has received financial support from the European Commission, as identified by grant agreement number: 847046 – 2018-BE-MORBIDITY.

The authors would like to thank the following people, who contributed to the project. In alphabetic order:

Alaerts Ine (Federal Public Service of Health, Food Chain Safety and Environment), Bossuyt Nathalie (Sciensano), De Ridder Karin (Sciensano), Geebelen Laurence (Sciensano), Gielen Birgit (IMA/AIM), Meeus Pascal (RIZIV/INAMI), Parmentier Yves (RIZIV/INAMI), Renard Françoise (Sciensano), Rodrigo Ruz Torres (RIZIV/INAMI), Ten Geuzendam Belinda (IMA/AIM),Vaes Bert (Intego), Vandael Eline (Sciensano), Van Bossuyt Melissa (Sciensano), Van Den Bogaert Bert (Sciensano), Van der Heyden Johan (Sciensano), Van Overloop Johan (IMA/AIM), Willemé Peter (Federal Planning Bureau)

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Annexes

A. DATA SOURCE SELECTION

Indicator	Disease	Measure	Remark	Reference Period	Label	ICD-10 Chapter	ICD-10 Code	ICD-9 Code	ICPC-2 Code
P1	**Diabetes mellitus**	**Incidence by Person**		1 year	ENMDs	IV	E10-E14	250	T89-T90
P2	**Diabetes mellitus**	**Period Prevalence**		3 years	ENMDs	IV	E10-E14	250	T89-T90
P3	**Dementia**	**Period Prevalence**	incl. Alzheimer's disease	3 years	MBDo	V	F00-F03, G30	290, 290.10, 290.11, 290.13, 290.21, 290.40, 290.41, 290.8, 290.9, 294.10, 294.11, 294.20, 294.21, 331.0, 331.19, 331.82	P70
P4	**Mental & behavioural disorders due to use of alcohol**	**Period Prevalence**	incl. Alcohol dependence	3 years	MBDo	V	F10	290	P15-P16
P5	**Schizophrenia, schizotypal & delusional disorders**	**Period Prevalence**		3 years	MBDo	V	F20-F29	295	P72
P6	**Mood (affective) disorders**	**Period Prevalence**		3 years	MBDo	V	F30-F39	301.12, 311	P73, P76
P7	**Anxiety disorders**	**Period Prevalence**		3 years	MBDo	V	F40-F41	-	P74, P79
P8	**Parkinson's disease**	**Period Prevalence**		3 years	DsNS	VI	G20	966.4, E936.4	N87
P9	**Multiple sclerosis**	**Period Prevalence**		3 years	DsNS	VI	G35	340	N86

P10	**Epilepsy**	**Period Prevalence**		3 years	DsNS	VI	G40-G41	345	N88
P11	**Hypertensive diseases**	**Incidence by Person**		1 year	DsCS	IX	I10-I13, I15	401-405	K86, K87
P12	**Hypertensive diseases**	**Period Prevalence**		3 years	DsCS	IX	I10-I13, I15	401-405	K86, K87
P13	**Ischaemic heart diseases**	**Period Prevalence**		3 years	DsCS	IX	I20-I25	410-414	K74-K76
P14	**Acute myocardial infarction**	**Incidence by Episode**		1 year	DsCS	IX	I21-I22	410	K75
P15	**Acute myocardial infarction**	**Incidence by Person**		1 year	DsCS	IX	I21-I22	410	K75
P16	**Heart failure**	**Period Prevalence**		3 years	DsCS	IX	I50	428	K77
P17	**Stroke**	**Incidence by Person**		1 year	DsCS	IX	I60-I64	430, 431, 432.0, 432.1, 432.9, 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91	K90
P18	**Cerebrovascular diseases**	**Period Prevalence**		3 years	DsCS	IX	I60-I69	430-438	K90, K91
P19	**Pneumonia**	**Incidence by Episode**		1 year	DsRS	X	J12-J18	480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482.0, 482.1, 482.2, 482.31, 482.32, 482.39, 482.40, 482.41, 482.42, 482.49, 482.81, 482.82, 482.83, 482.89, 482.9, 483.0, 483.1, 483.8, 484.7, 485, 486, 487.0, 514, 517.0	R81 (Not perfectly matched to ICD-10)

P20	**Asthma**	**Incidence by Person**		1 year	DsRS	X	J45-J46	493	R96
P21	**Asthma**	**Period Prevalence**		3 years	DsRS	X	J45-J46	493	R96
P22	**Chronic lower respiratory diseases other than asthma**	**Period Prevalence**	incl. COPD	3 years	DsRS	X	J40-J44, J47	490-492, 494, 496	R78, R79, R95, R99
P23	**Chronic obstructive pulmonary disease (COPD)**	**Period Prevalence**		3 years	DsRS	X	J44	490-492, 494, 496	R78, R79, R95, R99
P24	**Alcohol liver disease**	**Period Prevalence**		3 years	DsDS	XI	K70	571.0, 571.1, 571.2, 571.3, 572.2	D97
P25	**Diseases of liver other than alcoholic**	**Period Prevalence**		3 years	DsDS	XI	K71-K77	570, 571.40, 571.41, 571.42, 571.49, 571.5, 571.6, 571.8, 571.9, 572.0,572.1, 572.2, 572.3, 572.4, 572.8, 573.0, 573.3, 573.4, 573.5, 573.8, 573.9	D97
P26	**Diseases of liver**	**Period Prevalence**		3 years	DsDS	XI	K70-K77	570, 571.0, 571.1, 571.2, 571.3, 571.40, 571.41, 571.42, 571.49, 571.5, 571.6, 571.8, 571.9, 572.0, 572.1, 572.2, 572.3, 572.4, 572.8, 573.0, 573.3, 573.4, 573.5, 573.8, 573.9	D97
P27	**Rheumatoid arthritis**	**Period Prevalence**		3 years	DsMSCT	XIII	M05-M06	714	L88

P28	**Arthrosis**	**Period Prevalence**		3 years	DsMSCT	XIII	M15-M19	715	L89-L91
P29	**Osteoporosis**	**Period Prevalence**		3 years	DsMSCT	XIII	M80-M82	733.00, 733.01, 733.02, 733.03, 733.09, 733.10, 733.11, 733.12, 733.13, 733.14, 733.15, 733.16, 733.19, 733.81, 733.82, 905.1, 905.2, 905.3, 905.4, 905.5, V54.21, V54.22, V54.23, V54.26, V54.27, V54.29	L95
P30	**Renal failure**	**Period Prevalence**		3 years	DsGS	XIV	N17-N19	583-586	U99
P31	**Urolithiasis**	**Incidence by Person**		1 year	DsGS	XIV	N20-N23	592, 594	U14, U95
P32	**Intracranial injury**	**Incidence by Episode**		1 year	IPEC	XIX	S06	850-854	N79, N80
P33	**Intracranial injury**	**Incidence by Person**		1 year	IPEC	XIX	S06	850-854	N79, N80
P34	**Fracture of femur**	**Incidence by Episode**		1 year	IPEC	XIX	S72	820, 821	L75
P35	**Fracture of femur**	**Incidence by Person**		1 year	IPEC	XIX	S72	820, 821	L75

PB36	**Land transport accidents**	**Incidence by Episode**		1 year	ECMM	XX	V01-V89	E800-E829	-
PB37	**Land transport accidents**	**Incidence by Person**		1 year	ECMM	XX	V01-V89	E800-E829	-
PB38	**Accidental falls**	**Incidence by Episode**		1 year	ECMM	XX	W00-W19	E880-E888	-
PB39	**Accidental falls**	**Incidence by Person**		1 year	ECMM	XX	W00-W19	E880-E888	-
PB40	**Intentional self harm**	**Incidence by Episode**	incl. suicidal attempt	1 year	ECMM	XX	X60-X84	E950-E959	-
PB41	**Intentional self harm**	**Incidence by Person**	incl. suicidal attempt	1 year	ECMM	XX	X60-X84	E950-E959	-
PB42	**Complications of medical and surgical care**	**Incidence by Episode**		1 year	ECMM	XX	Y40-Y66, Y69-Y84	E870-E876, E878-E879, E930-E949	-
PB43	**Complications of medical and surgical care**	**Incidence by Person**		1 year	ECMM	XX	Y40-Y66, Y69-Y84	E870-E876, E878-E879, E930-E949	-

Indicator	Pref. Data Source 1	Pref. Data Source 2	Pref. Data Source 3	Notes Data Source	DiagnosisType	ATC-code(s) EPS	ATC-code(s) Guidelines	Data Quality
P1	Permananent Sample of Health Insureds	Intego		Correction by calculated ratio from EPS data (but incidence ?)	Pseudo-diagnostic	A10A, A10B	A10	2. Good coverage & completeness
P2	Permananent Sample of Health Insureds				Pseudo-diagnostic	A10A, A10B	A10	2. Good coverage & completeness
P3	Permananent Sample of Health Insureds	Intego			Diagnostic		N06DA, N06DX01	2. Good coverage & completeness
P4	Intego			Correction by calculated ratio from HIS data	Diagnostic			4. Doubtful quality
P5	Permananent Sample of Health Insureds				Pseudo-diagnostic	N05AA, N05AB, N05AC, N05AD, N05AE, N05AF, N05AG, N05AH, N05AN, N05AX, N07XX06	N05A (except N05AN)	3. Doubtful completeness / methods
P6	Intego				Diagnostic		N06A,N06C,N05AN except N06AX01 and N06AX02	3. Doubtful completeness / methods
P7	Intego	National Hospital Stay Database		Preference to specific survey, validation/correction using HIS. MZG can deliver psychologic data?	Non-diagnostic			3. Doubtful completeness / methods
P8	Intego			Correction by calculated ratio from EPS or HIS data	Diagnostic	N04AB, N04AC, N04B	N04	3. Doubtful completeness / methods

P9	Permananent Sample of Health Insureds				Pseudo-diagnostic	L03AB07, L03AB08, L03AX13, L05AA23, L05AA27, L05AA31, L05AA34, N07XX09		3. Doubtful completeness / methods
P10	Intego			Correction by calculated ratio from EPS data	Diagnostic	N03	N03, N05BA, N05CD	3. Doubtful completeness / methods
P11	Intego				Diagnostic		C03AA C03AB C03AH C03AX01 C02CA04 C03BA C03DB C03EA C09BA02 C09BA03 C09BA04 C09BA05 C09BA06 C09BA07 C09BA08 C09BA09 C09BB C09DB C09DA02 C09DA03 C09DA04 C09DA06 C09DA07 C09DA01 C02AB01 C02AB02 C02AC01 C02AC02 C02AC04 C02AC05 C02DB02 C02DB03 C02DB04 C02DC01 C02DD01 C02DG01 C02KA01 C02KB01 C02KC01 C02KD01 C02KX01 C09XA	2. Good coverage & completeness
P12	Intego			Combined with EPS data during reference year to exclude lifetime prevalence	Diagnostic		C03AA C03AB C03AH C03AX01 C02CA04 C03BA C03DB C03EA C09BA02 C09BA03 C09BA04 C09BA05 C09BA06 C09BA07 C09BA08 C09BA09 C09BB C09DB C09DA02	2. Good coverage & completeness

							C09DA03 C09DA04 C09DA06 C09DA07 C09DA01 C02AB01 C02AB02 C02AC01 C02AC02 C02AC04 C02AC05 C02DB02 C02DB03 C02DB04 C02DC01 C02DD01 C02DG01 C02KA01 C02KB01 C02KC01 C02KD01 C02KX01 C09XA	
P13	Intego			Correction by calculated ratio from HIS data	Diagnostic		C01DA	2. Good coverage & completeness
P14	National Hospital Stay Database	Cause of Death Registry		CDR data inclusion for calculation of total unique cases	Diagnostic			1. Good quality
P15	National Hospital Stay Database	Cause of Death Registry		CDR data inclusion for calculation of total unique cases	Diagnostic			1. Good quality
P16	Intego			Correction by calculated ratio from EPS data	Diagnostic			3. Doubtful completeness / methods
P17	National Hospital Stay Database	Cause of Death Registry		CDR data inclusion for calculation of total unique cases	Diagnostic			1. Good quality
P18	National Hospital Stay Database	Cause of Death Registry		CDR data inclusion for calculation of total unique cases	Diagnostic			1. Good quality
P19	Intego	National Hospital Stay Database		Correction by calculated ratio from HDD data	Diagnostic			4. Doubtful quality
P20	Intego			Correction by calculated ratio from HIS data	Diagnostic	R03DC01, R03DC03, R03DX05 - R03A, R03BA - R03	R03 (below 50 years of age)	2. Good coverage & completeness

P21	Intego			Correction by calculated ratio from HIS data	Diagnostic	R03DC01, R03DC03, R03DX05 - R03A, R03BA - R03	R03 (below 50 years of age)	2. Good coverage & completeness
P22	Intego			Correction by calculated ratio from HIS data	Diagnostic		R03	3. Doubtful completeness / methods
P23	Intego			Correction by calculated ratio from HIS data	Diagnostic	R03BB, R03DA04 - R031, R03BA - R03	R03	3. Doubtful completeness / methods
P24	Intego			Using Pooled liver diseases & HIS data to estimate subdivision proportion	Diagnostic			4. Doubtful quality
P25	Intego			Using Pooled liver diseases & HIS data to estimate subdivision proportion	Diagnostic			4. Doubtful quality
P26	Intego			Correction by calculated ratio from HIS data	Diagnostic			3. Doubtful completeness / methods
P27	Intego			Correction by calculated ratio from HIS data	Diagnostic	L04AA11, L04AA12, L04AB01, L04AB02 - L04AA12, A07EC01, A07EC02 - L04AA24, L04AB04, L04AB05, L04AB06, L04AB07		3. Doubtful completeness / methods
P28	Intego			Correction by calculated ratio from HIS data	Diagnostic			3. Doubtful completeness / methods
P29	Intego			Correction by calculated ratio from HIS data	Diagnostic		A12A, G03XC, H05A, M05B	3. Doubtful completeness / methods

P30	Intego	European Dialysis and Transplant Association		Intego can deliver results on whole-stage prevalence. EDTA can only register end-stage prevalence (narrower definition, to be used as alternative/validation)	Diagnostic			2. Good coverage & completeness
P31	National Hospital Stay Database				Diagnostic			4. Doubtful quality
P32	National Hospital Stay Database	Cause of Death Registry			Diagnostic			2. Good coverage & completeness
P33	National Hospital Stay Database	Cause of Death Registry			Diagnostic			2. Good coverage & completeness
P34	National Hospital Stay Database				Diagnostic			1. Good quality
P35	National Hospital Stay Database				Diagnostic			1. Good quality
PB36	National Hospital Stay Database	Cause of Death Registry		Road Trafic Accident registry can be used for verification or correction. RTA not based on diagnostic data. NHSD expected to underestimate incidence	Non-diagnostic			4. Doubtful quality
PB37	National Hospital Stay Database	Cause of Death Registry		RTA registry does not allow to link multiple accidents to one person, IP not computable. NHSD delivers underestimation				4. Doubtful quality

PB38	National Hospital Stay Database	Intego		NHSD only most severe cases, serious underestimation. Possible correction using HIS. Intego possible less severe cases - eg. Sprained ankle	Diagnostic			3. Doubtful completeness / methods
PB39	National Hospital Stay Database	Intego		NHSD only most severe cases, serious underestimation. Possible correction using HIS. Intego possible less severe cases - eg. Sprained ankle	Diagnostic			3. Doubtful completeness / methods
PB40	Sentinal Network of General Practices			Def. limited to suicidal attempt	Diagnostic			3. Doubtful completeness / methods
PB41	Sentinal Network of General Practices			Def. limited to suicidal attempt	Diagnostic			3. Doubtful completeness / methods
PB42	National Hospital Stay Database	Cause of Death Registry	Intego	Most severe cases + deceased patients only. Narrow definition. Intego possible less severe - eg. Mild allergy	Diagnostic			3. Doubtful completeness / methods
PB43	National Hospital Stay Database	Cause of Death Registry	Intego	Most severe cases + deceased patients only. Narrow definition. Intego possible less severe - eg. Mild allergy	Diagnostic			3. Doubtful completeness / methods

B. INTERMEDIARY RESULTS

The intermediary results can be found in the Excel file "*BE_MORB_DATA_TEMP.xlsx*", along with the corresponding intermediary metadata file "*BE_MORB_METADATA_TEMP.xlsx*".

C. MEETINGS WITH EXTERNAL STAKEHOLDERS

Date	Subject
10/04/2019	Task Force on Morbidity Statistics
25/04/2019	Internal kick-off meeting of the Morbidity Statistics pilot data collection
26/04/2019	Stakeholder meeting & project introduction with Intego Network of General Practitioners and their role in the Morbidity Statistics project
7/05/2019	In-house meeting on the previous phases of the Morbidity Statistics project
12/06/2019	Stakeholder meeting & project introduction with the FPS Health, Food Chain Safety & Environment regarding the role of the MHD and the NHSD
02/07/2019	Stakeholder meeting & project introduction with the IMA/AIM and the role of the EPS data in the Morbidity Statistics project
11/09/2019	In-house meeting regarding the data regulations and data access
26/11/2019	Stakeholder meeting with the Belgian Focal Point & introduction/clarification of the Morbidity Statistics project